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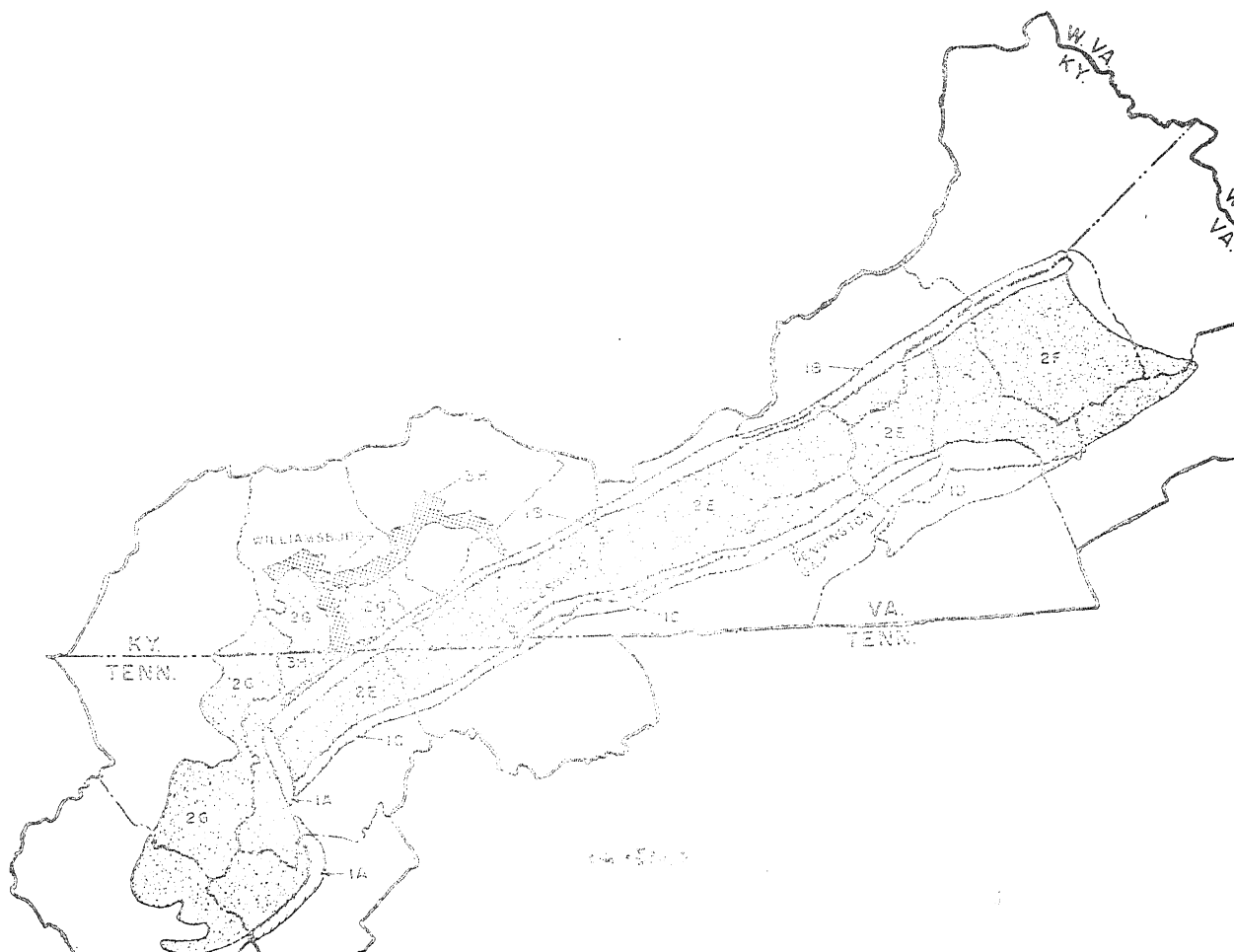
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Classification and Evaluation Forest Sites in the Cumberland Mountains

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SUMMARY

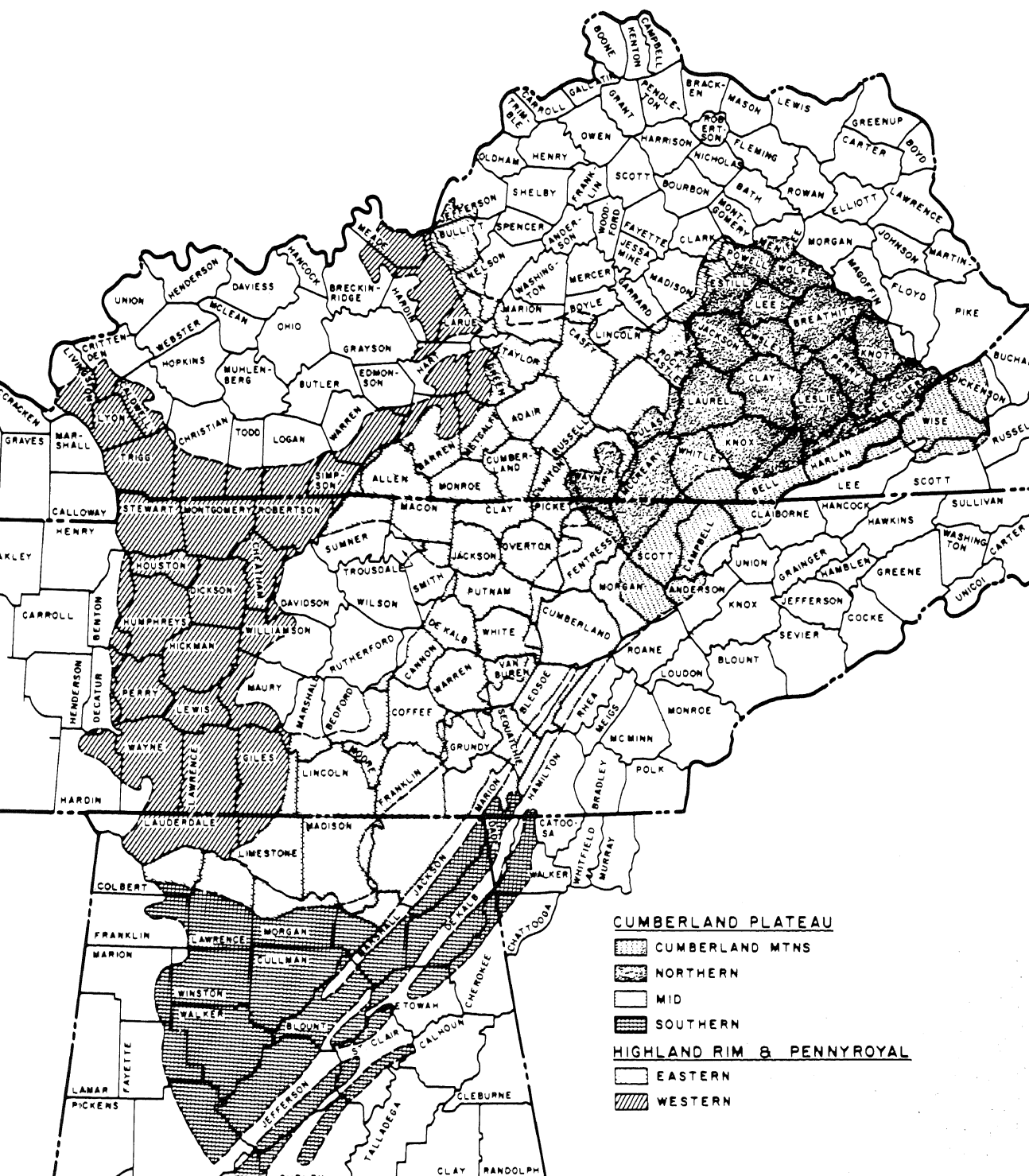
This paper presents a comprehensive forest site classification system for the Cumberland Mountains in north central Tennessee, southeastern Kentucky, and southwestern Virginia. The system is based on physiography, geology, soils, topography, and vegetation. Thirty landtypes are described and evaluated in terms of productivity and desirability of selected pines and hardwoods for timber production. Also, each landtype is rated for five soil-related problems that can affect forest management operations.

ACKNOWLEDGMENTS

I am indebted to my colleagues, past and present, for their scientific input, reviews, and stimulating discussions. I am also grateful to the soil scientists, silviculturists, plant ecologists, and practicing foresters who have reviewed this guide.

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Classification and Evaluation of Forest Sites in The Cumberland Mountains

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INTRODUCTION

This report classifies and evaluates forest sites in the Cumberland Mountains (fig. 1) for the management of several commercially valuable tree species. It provides forest managers with a land classification system that will enable them to subdivide forest land into logical segments (landtypes), allow them to rate productivity, and alert them to any limitations and hazards that the landtypes impose on forest management activities. Though soils information is an integral part of this system, users will not need to identify and classify soils or to make laboratory determinations. This report is oriented to timber production because timber is usually a major management objective. However, landtypes can also be the basis for the management and interpretation of other forest resources.

I have drawn freely on much published information on geology, physiography, soils, sites, and yields. In many cases, data specific to this area were not available, so information was extrapolated from adjacent regions. Extrapolation was particularly necessary with productivity data. All sources of data are documented, so the user can gauge the accuracy and reliability of the information.

Productivity and management problem information is presented in a format that follows the outline used by the Soil Conservation Service (SCS) in the Woodland Suitability sections of county soil surveys. The similarity should facilitate the integration of information contained in county soil surveys with this classification system.

This guide represents the best information and collective judgment now available. Nevertheless, it is still incomplete. I trust that forest managers, after applying this site classification system, will share their experience with me and make me aware of any shortcomings or needed revisions.

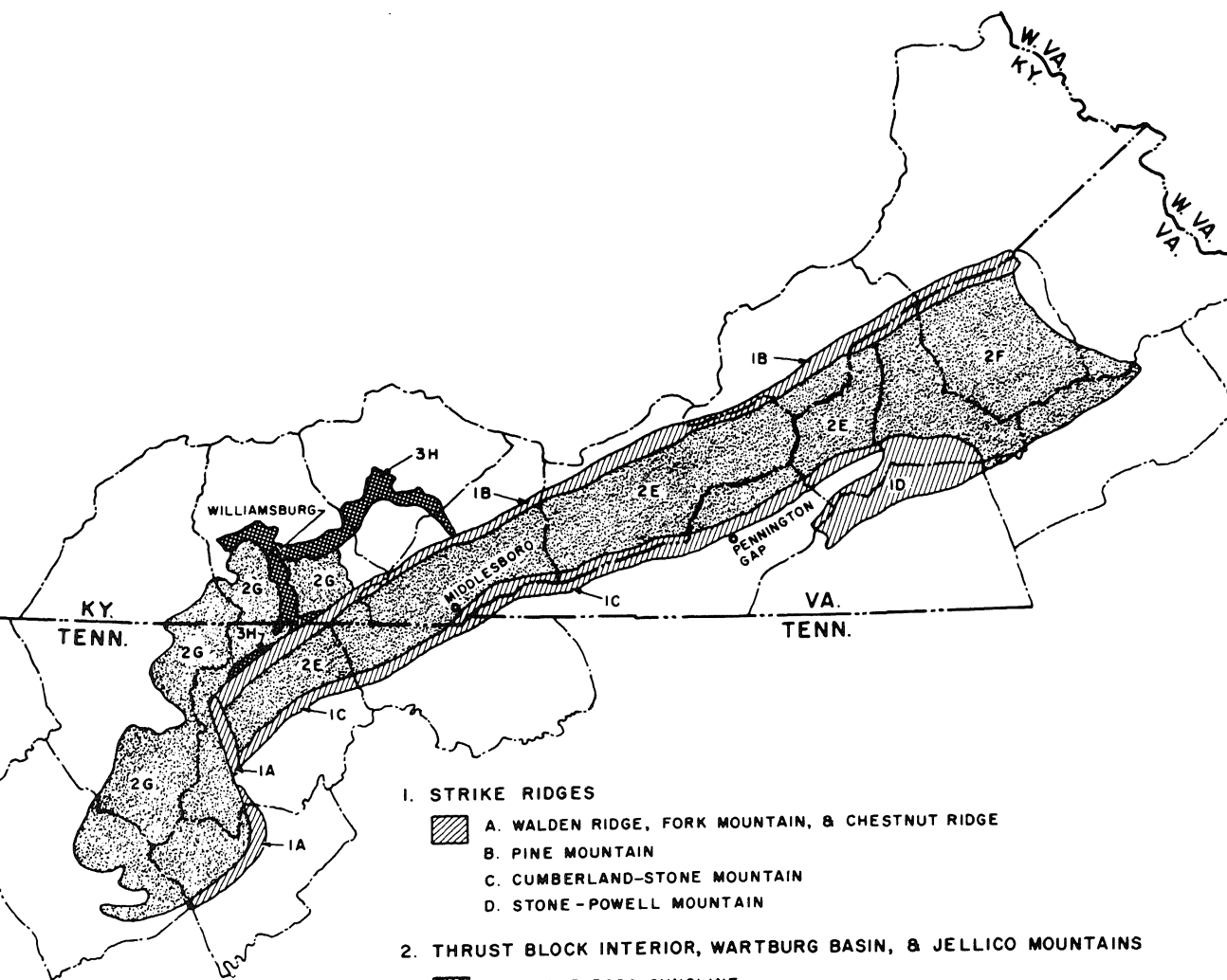
Uplands appeared in the proceedings of the Second Central Hardwood Forest Conference (Smalley 1979a) and the Forest Soils and Site Quality Workshop (Smalley 1979a). Site classification guides for the Southern Cumberland Plateau, the Western Highland Rim and Pennyroyal, the Mid-Cumberland Plateau, and the Eastern Highland Rim and Pennyroyal Regions have been published (Smalley 1979b, 1982, 1983).

CUMBERLAND MOUNTAINS REGION

The Cumberland Mountains region covers about 2,900 mi² in all or part of five counties in Tennessee, six in Kentucky, and six in Virginia. The region extends south to north from about north latitude 36°5' to 37°20' and east to west from about west longitude 81°55' to 84°40'. It extends from near the Emory River in Morgan County, Tennessee, northward to the Russell Fork River in Dickenson County, Virginia, a distance of about 154 mi (fig. 2).

The Cumberland Mountains consist of the Cumberland overthrust block and the Wartburg Basin (Fenneman 1938, Luther 1977). The region is distinguished by elevation and relief, being everywhere higher than the adjacent Cumberland Plateau and the Powell Valley section of the Ridge and Valley physiographic province.

The Cumberland overthrust block is more accurately called the Pine Mountain thrust plate, reflecting current thought that the thrust plate is the result of thin-skinned tectonics (Harris 1970). The Pine Mountain thrust plate straddles the Tennessee, Kentucky, and Virginia boundaries. This quadrilateral thrust plate is bounded on the northwest by Pine Mountain; on the southeast by Cumberland, Stone, and Powell Mountains; on the northeast by the Russell Fork River; and on the southwest by Cove Creek.



1. STRIKE RIDGES

-  A. WALDEN RIDGE, FORK MOUNTAIN, & CHESTNUT RIDGE
-  B. PINE MOUNTAIN
-  C. CUMBERLAND-STONE MOUNTAIN
-  D. STONE-POWELL MOUNTAIN

2. THRUST BLOCK INTERIOR, WARTBURG BASIN, & JELICO MOUNTAINS

-  E. MIDDLESBORO SYNCLINE
-  F. PINE MOUNTAIN THRUST PLATE SYNCLINE
-  G. WARTBURG BASIN-JELICO MOUNTAINS

3. MAJOR RIVER BOTTOMS

-  H. CUMBERLAND RIVER

The Wartburg Basin, adjacent to the southwest of the Pine Mountain thrust plate, is included in the Cumberland Mountain region because it is similar geologically to the interior of the thrust plate (Middlesboro Basin). The Wartburg Basin is bounded on the northeast by the Jacksboro fault, on the southwest by Walden Ridge, and on the south by the Henry River and Whetstone Mountain faults. It is delimited geologically on the northwest, where it merges with the Cumberland Plateau.

Climate

The region has a temperate climate characterized by long, moderately hot summers and short, mild to moderately cold winters. According to Thornthwaite's (1948) classification of climate, it is humid mesothermal, with adequate precipitation at all seasons. Daily and seasonal weather is controlled largely by alternating cold, dry continental air masses from Canada and warm, moist air from the Gulf of Mexico. During the summer, complete exchanges of air masses are few and tropical maritime air masses persist for extended periods. Long periods of mild, sunny weather typically occur in the fall. Tables 1 and 2 show average monthly and annual precipitation and temperature values, average frost-free periods, and elevation above mean sea level for two stations in Kentucky and one in Virginia (fig. 2). No station was located in the Tennessee portion of the region.

Mean temperature for the region is about 55°F. The date of last freeze is mid-April, and the date of first freeze is mid- to late October. The frost-free period ranges from 180 to 190 days but may be 10 to 20 days shorter at the highest elevations. The temperature often falls below freezing at night in December, January, and February. The ground freezes to a depth of 2 to 8 in several times during the average winter season and commonly remains frozen for 3 to 14 days. Though air temperature does not appear to vary much across the region, local temperatures vary considerably because of elevation, aspect, and cloud cover. In summer, the valleys are very warm and occasionally hot, and the mountains are warm during the day but are cool at night. In winter, the valleys are very cool with occasional cold and warm spells while upper slopes and mountaintops are generally cold.

Southerly winds prevail from May to September and northerly ones from November to March; average velocity ranges from 5 to 10 mph but probably exceeds 10 mph on the mountaintops. Infrequent severe winds are usually associated with late spring and summer thundershowers.

Annual precipitation, averaging about 49 in., is ordinarily well-distributed throughout the year. Precipitation is greatest from December through March and least from August through November. Short periods of very wet or very dry weather are common. Thunderstorms that commonly occur from March

Table 1.—Average monthly and annual precipitation in inches and elevation above mean sea level for three weather stations in the Cumberland Mountains¹

Station and county	Years of record	Elevation (ft)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Middlesboro, KY	85	1,175	4.84	4.47	5.20	4.04	3.71	4.53	4.95	3.96	2.87	2.64	3.83	4.83	4.50
Diambsburg, KY	89	1,000	4.36	4.28	4.79	4.01	3.95	4.14	5.09	3.62	2.89	2.59	3.76	4.05	4.25
Whitley, KY															
Winning Gap, VA	44	1,510	4.87	4.76	5.48	3.93	3.69	4.09	5.46	4.09	3.20	2.45	3.71	4.56	5.00

¹U.S. Department of Commerce (1976a, 1976b).

Table 2.—Average monthly and annual temperature (°F) and length of warm period for three weather stations in the Cumberland Mountains

Station and county	Years of record	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year	Warm period (days)
Middlesboro, KY	85	38	42	48	53	58	63	68	72	75	78	80	82	63	210
Diambsburg, KY	89	37	41	47	52	57	62	67	71	74	77	79	81	62	208
Whitley, KY															
Winning Gap, VA	44	39	43	49	54	59	64	69	73	76	79	81	83	64	212

rough August are of short duration. Steady rains lasting several days sometimes occur in winter and late spring. Those storms are likely to cause local flooding in the mountains because soils are saturated, frozen, or snow-covered. In the winter, precipitation is chiefly rain in the valleys and snow, sleet, or freezing rain on the mountaintops. Average annual snowfall is 10 to 14 in, but snow persists for periods longer than a few days only at the highest elevations. Soils are wettest from December through April and driest from July to October. On the average, tree growth is probably retarded for periods of a few days less than 10 times each growing season. More severe droughts are common on upper mountain slopes facing south and west.

Soil dryness during the growing season can also be shown by "frequency of drought days" data (Knetsch and Smallshaw 1958). A drought day occurs when precipitation and evapotranspiration data indicate that soil moisture content is below the wilting point. At Dante in Russell County, Va. (about 15 mi east of Wise, Va.), drought days are most likely to occur in September when the probability of 10 drought days per month is 9 percent and least likely in June, July, August, and October when the probability is 3 percent or less. During the April to October growing season, there is a 24 percent probability of 10 drought days. These low probabilities indicate that precipitation in the Cumberland Mountains is well-distributed throughout the growing season in most years. These data were collected for soils having 4 in of available water storage. The probability of drought will be greater on soils with less storage capacity and vice versa.

Geology, Topography, and Soils

The Cumberland Mountains region consists of the Pine Mountain thrust plate and the Wartburg Basin-Jellico Mountains and is underlain by Pennsylvanian shales, siltstones, sandstones, and coal. The thrust plate is delineated by prominent strike ridges—Pine Mountain on the northwest and Cumberland-Stone Mountain on the southeast (Wilson and others 1956, Wilson and Stearns 1958, McFarlan 1943, Dietrick 1970). The Pine Mountain thrust fault is a complex system that initially formed at different stratigraphic levels along, as well as across, strike.

Along Pine Mountain, the leading edge of the thrust plate, strata dip 10° to 35° to the southeast.

flank of Pine Mountain and the northwest flank of Cumberland-Stone Mountain are capped with late Pennsylvanian strata belonging to the sandstone-dominated Gizzard and Crab Orchard Mountain groups in Tennessee (Wilson and others 1956) and the Pennington and Lee formations in Kentucky and Virginia (Englund 1968, McDowell and others 1981, Milici and others 1963). In places, the inclination of the mountain slopes is parallel or nearly so to the dip of the strata.

Northwest of the Pine Mountain thrust in Tennessee and Kentucky are subsidiary fault slices, which consist of intensely deformed strata of the Gizzard and Crab Orchard Mountain groups or Lee Formation (Wilson and Stearns 1958, Englund 1968). South of the Pine Mountain thrust on the northeast side of the Jacksboro fault is a prominent anticlinal ridge. The Fork Mountain and Chestnut Ridge—where intensely deformed strata of the Gizzard and Crab Orchard Mountain groups are faulted against younger, nearly horizontal rocks of the Slatestone group. Titus Creek flows through Sharp Gap, which separates Pine Mountain and Chestnut Ridge. Along the Jacksboro fault, strata were moved northwestward about 1 mi and raised about 500 ft above their normal level above the adjacent Cumberland Plateau. On the north end of Pine Mountain, thrust movement along the Russell Fork fault was about 4 mi.

Alluvial deposits of Quaternary age occur along the Cumberland River, Russell Fork, Clear Fork, Elk Valley, and in the vicinity of Middlesboro, Kentucky (Swingle and others 1966, Englund 1968, McDowell and others 1981).

The interior of the Pine Mountain thrust plate is divided into the Middlesboro syncline and the Pine Mountain thrust plate syncline (Harris 1970). The two basins are separated by the Buck Knob anticline, which extends from the head of Powell Valley near Norton, Va., northward to near Pound Gap. The Middlesboro Basin contains high, rugged mountains underlain by Slatestone to Cross Mountain formations in Tennessee (Wilson and others 1956), members of the lower and middle Breathitt formations in Kentucky (McDowell and others 1981), and Wise and Harlan formations in Virginia (Milici and others 1963). Pine Mountain syncline is less rugged and underlain by older Pennsylvanian rocks belonging to the Gladeville and Norton formations (Milici and others 1963).

The Wartburg Basin and Jellico Mountains

member of the Crooked Fork group, serves as the approximate boundary between the Cumberland Plateau and the Wartburg Basin portion of the Cumberland Mountains. Wartburg sandstone forms the broad topographic bench surrounding the Wartburg Basin on the south, west, and northwest. This sandstone marks the top of the lower sandy division of Pennsylvanian rocks. The corresponding stratum in Kentucky is the Corbin sandstone. Strata above the Wartburg and Corbin sandstones belong to the upper sandy division of Pennsylvanian rocks.

Study of the geology of the Cumberland Mountains region is difficult because different stratigraphic nomenclatures were developed in each of the three States. Some strata, including coal seams, have been assigned the same names, and, in some places, contacts between units coincide; but, in most cases, names are different and units do not coincide. Several correlations have been attempted, although no recent regional correlation is available (Wilson and others 1956, Stearns and Mitchum 1962, Englund 1968, Colton 1970).

An attempt at such a correlation may be futile since contacts are arbitrarily defined in a repetitious sequence of sandstone, siltstone, shale, coal, underlay, and argillaceous limestone. Also, the characteristics of the strata change from place to place so that what is thick and readily mappable at one place may be thin and obscure at another. Consequently, the advantages and disadvantages of each nomenclature are dependent on the local character of the strata (Englund 1968).

Topography of the region ranges from gentle to rugged and complex, and is characterized by steep slopes, narrow crests, and narrow winding valleys. Slopes vary from nearly level to very steep, but most are 20 to 60 percent. Elevation ranges from 1,200 to 4,000 ft above mean sea level, with a few peaks exceeding 4,000 ft. Some smooth land occurs on broader mountaintops, footslopes, and benches and along larger mountain streams, particularly in the Pine Mountain thrust plate basin.

Elevation of the Pine Mountain varies from 2,100 to 2,300 ft at the southern end and rises gradually to 2,600 to 2,800 ft, and locally to 3,000 ft, at the northern end. Everywhere, it is 600 to 800 ft higher than the adjacent Cumberland Plateau. Elevation of Cumberland-Stone Mountain varies from 2,500 to 3,000 ft over much of its extent and occasionally exceeds

Tennessee has an elevation of 3,534 ft, and "Double" on Black and Log Mountains in Kentucky rises to 4,150 ft and 3,200 ft, respectively. Local elevations range from 1,000 to 1,400 ft and may be as much as 2,500 ft in the vicinity of the highest peaks. Consistent free faces and benches have developed on the more resistant strata of sandstone.

Topography of the Pine Mountain thrust plate syncline is not as high or as dissected as other parts of the Cumberland Mountains—ridgetops and broader, smoother land is more prevalent, and the landscape is more nearly like the Mid- and North Carolina Cumberland Plateau than the Cumberland Mountains.

The majority of the Cumberland Mountain region drains into the Cumberland River and its tributaries, while a small portion drains into the Emory, Powell, and Clinch Rivers, major tributaries of the Tennessee River. The northeast end of the Pine Mountain thrust plate is drained by the Russell Fork River, a tributary of the Big Sandy River. The Russell Fork River crosses the north end of Pine Mountain in a gorge nearly 1 mi long and almost 1,000 ft deep known as "Breaks of the Cumberland." Situated within Breaks Interstate Park, the gorge contains many remarkable erosional features (Dietrich 1970).

The Cumberland River breaches Pine Mountain near Pineville in a narrow water gap at an elevation of about 1,000 ft, then turns northeastward and follows the back slope of Pine Mountain for nearly 6 miles. Clear Fork cuts through Pine Mountain near Johnsons Creek and U.S. Highway 23 passes through a gap near Pound, Ky.

Cumberland Gap is the well-known pass in the Cumberland Mountain through which Daniel Boone and other early explorers and settlers travelled. Stone Mountain is breached by the North Fork of the Clinch River at Pennington Gap and the main Clinch River at Big Stone Gap, Va.

Soils are mostly pale, loamy, and friable and are rich in content of sandstone and shale fragments. Podzols with dark surface horizons occur at high elevations, especially in coves, and on cool slopes. The more extensive soils are classified as loamy, mixed or siliceous, mesic, and are trochrepts and Hapludults. Soils forming in material from surface mining of coal are classified as Udorthents.

On upper mountain slopes, soils formed from sandstone, depending on elevation. Probably

mountain streams, discontinuous flood plains are typically long and narrow and rimmed with steep rocky ledges. Downstream along the larger creeks and rivers, flood plains and terraces are more extensive (Springer and Elder 1980, Lietzke and Porter 1978, Franzmeier and others 1969, Bailey and Winsor 1964).

Common upland soils are Lily, Ramsey, Muskinum, Gilpin, Latham, Petros, Alticrest, Berks, and McKalb. Common colluvial soils are Grimsley, Jefferson, Shelocta, Bouldin, Rigley, and Zenith. Common alluvial soils are Sewanee, Ealy, Cuba, Stendal, Bone, Pope, Philo, Stokly, Clifty, and Atkins.

There is little smooth land in the Cumberland Mountains region, and most of it is used for agriculture or building sites. Hardwood and pine forests occupy 57 to 90 percent of Cumberland Mountains counties (Hedlund and Earles 1971, Knight and McClure 1978, Kingsley and Powell 1978). Counties with the lowest percentages of forest land reflect the fact that part of the area lies in the Ridge and Valley physiographic province. Large tracts are owned by timber and coal companies. Part of the Clinch Ranger District of the Jefferson National Forest lies in the Cumberland Mountains.

Much land has been disturbed by surface mining for coal, and regulations now require rehabilitation. Some reclaimed land is being used for shopping centers, schools, athletic fields, subdivisions, and improved pasture. Most land disturbed before passage of reclamation laws is gradually reverting to forest. Soil erosion, stream sedimentation, and surface and ground-water pollution are serious problems.

Gradient, aspect, slope length, and soil moisture are important factors in the delineation of landtypes described later. Slope steepness, soil thickness, and topographic position affect the rate and amount of both surface runoff and subsurface movement of soil water. Soil loss by erosion increases as gradient and length of slope increase. Although surface runoff and soil erosion are rare under forested conditions, they are important factors during road construction, logging, and other forest management operations. Dumping of the soil mass is fairly common on undisturbed steep slopes. Soils on short steep slopes are often shallower than soils on more nearly level terrain, while those on long steep slopes are often very deep. Deposition of sediments on gentle terrain by

ally, soil temperatures are lower on north-facing than on south-facing slopes. Because soils on north-facing slopes tend to retain moisture for longer periods during the growing season, rate of tree growth is faster and species composition is richer.

Franzmeier and others (1969) in a study of soil properties on steep north- and south-facing slopes in the Cumberland Mountains in Morgan County, Tennessee, found that, at a depth of 20 in, lower slopes were cooler than mid- and upper slopes. Lower slopes were shaded in the morning and evening by adjacent mountains in this steep, highly dissected landscape and also tended to be more moist than higher slope positions because of internal moisture flow. The cooler, moister soils warm more slowly because of the relatively high specific heat of water and the shorter periods of time they are exposed to direct sunlight.

Lee and Sypolt (1974), however, suggested that in areas of high summer precipitation, such as the Cumberland Mountains, marked differences in tree growth are not associated with soil moisture differences. During midday on south-facing slopes, it appears that (1) super-optimum temperatures for photosynthesis frequently occur in forest canopies, (2) lower soil temperatures limit the absorption of available water, and (3) higher canopy temperatures increase the transpiration demand, create leaf water deficits earlier in the day, and magnify the midday depression of net assimilation.

Shading by an adjacent landmass is an important site factor in highly dissected landscapes. Attempts have been made to quantify the effects of shading on the growth of black cherry in the Allegheny Mountains of Pennsylvania (Davis 1966) and of chestnut, oak, white oak, and yellow-poplar in the Cumberland Mountains of Tennessee (Rodriguez 1973) using the angle to the top of the shading landmass situated to the south. However, very little of the total variation in tree growth was attributed to this angular measurement. The effect of shading is complex and, evidently, a simple angular measurement does not explain this complexity. A thorough study is needed to quantify both the areal and temporal effects of shading on tree growth in steep, highly dissected landscapes.

In Soil Taxonomy, temperature regime is one of several differentiae used to group soils within a subgroup having similar physical and chemical properties.

description of landtypes that follows, both mesic and thermic soils are listed as occurring on a few landtypes to conform to current SCS classification. Soils differing only in temperature regime seem to have similar tree growth potential and management problem interpretations. However, average annual soil temperature does not reflect the daily and seasonal fluctuations, particularly in the top few inches. These fluctuations probably influence tree growth more than an average temperature.

It is commonly thought that soils on steep mountain slopes have thin, weakly developed soils over bedrock. Soils developed from acid siltstones and shales in the Cumberland Mountains of Tennessee and the northern Cumberland Plateau of south central Kentucky have deep, well-developed soils and appear relatively stable despite fairly steep slopes (Braunmeier and others 1969). Soils on midslopes have greater contents of rock fragments than those on upper or lower slopes. Soils on lower slopes have higher base status. Most soils on south slopes have argillic horizons while most soils on north slopes have cambic horizons. Soils on north slopes have almost 1°C lower mean annual temperature, contain more organic matter, are darker in color, and hold more water during periods of water stress than soils on south slopes.

Vegetation

The late Dr. E. Lucy Braun conducted extensive vegetation studies of the Cumberland Plateau and Cumberland Mountains in the 1930's and 1940's. This research formed the basis for her concepts of deciduous forest development and succession, which were synthesized in her book *Deciduous Forests of Eastern North America* (Braun 1950). This volume remains the only authoritative description of the eastern deciduous forest.

Braun's Cumberland Mountain section of the Mixed Mesophytic Forest region is coextensive with Inneman's (1938) physiographic region of the same name. She included the mountainous Wartburg Basin lying west and south of the Cumberland Plateau as a forest trust plate in the Cumberland Mountains section and referred to it as "the outlying area."

According to Braun, the mixed mesophytic forest reaches its best development in the Cumberland Mountains. The dominant climax species of American beech, yellow-poplar, white basswood, sugar

number of dominants in the climax. A dozen or more additional tree species seldom or never attain canopy position. The shrub and herbaceous vegetation is diverse and varied.

The primary forest is a mosaic of climax and subclimax communities. Diversity in topography, soil, and microclimate is largely responsible for the complexity of the mixed mesophytic forest. American beech and white oak dominate southerly slopes at elevations below 2,000 ft. Beech seldom occurs above 2,000 ft, but white oak occurs at higher elevations and on cool aspects. Sugar maple—basswood—buckeye or sugar maple—basswood—buckeye—yellow-poplar communities are prominent at middle elevations. Shortleaf, pitch, and Virginia pines are common on the shallow sandstone-derived soils of the back slopes of Pine, Cumberland, Stone, and Poverty Mountains. The mixed mesophytic forest prevails throughout the Wartburg Basin except on sandstone-derived soils and ridge crests where subclimax oak-hickory stands occur.

Current forests bear little or no resemblance to those that Braun described 40 to 50 years ago. American chestnut is gone, and extensive logging, coal mining, and wildfire have all caused drastic changes in tree size and composition of Cumberland Mountain forests. Selectively logged stands have similar composition but lack the large trees seen in photos illustrating Braun's book (1950, chapter 4). A few scattered old-growth remnants of the mixed mesophytic forest remain (Hinkle 1975). Recent studies characterize the existing forests.

DeSelm and others (1978) studied the forest vegetation of Wilson Mountain, the west end of Little Brushy Mountain in Morgan County, Tenn. Wilson Mountain, located at the southern end of the Wartburg Basin, rises to an elevation of 2,260 ft, which is 800 to 900 ft above the adjacent valleys. Sporadic timber harvesting occurred from early 1800 to 1910 by various owners; three seams of coal were mined between 1953–1957; and evidence of fires was found on lower slopes. Five communities were recognized: shortleaf pine on southern spur ridges, yellow-poplar in most north drainages, northern red oak on upper north slopes, white oak on most lower slopes (but also dominating some upper slopes), and chestnut oak on most mid-north and upper south slopes.

Composition (frequency of occurrence) and density (number of stems per acre) of tree reproduction

significant relationship between densities of overstory and understory. One or more of five soil and site variables was significantly correlated with understory density of twelve species, but only a small proportion of the total variation was explained by regression.

Cabrera (1969) described an old-growth deciduous forest on Ash Log Mountain about 20 mi northeast of Wilson Mountain. Ash Log Mountain rises to 3,240 ft, with local relief of about 1,400 ft. Slopes ranged from 10 to 140 percent, but most were 40 to 60 percent. North slopes typically had mull types of humus while west and southwest slopes had mor types. Three communities were recognized: sugar maple—yellow-poplar—basswood—buckeye in north coves, sugar maple—northern red oak—yellow-poplar—black locust on north and west spur ridges and on east and northwest slopes and coves, and chestnut oak—black locust on west and southwest spur ridges and coves. American beech occurred only below 2,000 ft elevation, where most sampled slopes had west and southwest exposures. The low density of seedlings and saplings of black locust suggested a temporary dominance of this species.

In a study of the relationship of soils and vegetation to topography and elevation in the Cumberland Mountains near Caryville in Campbell County, Tenn., Knight (1979) observed that mixed oak forests dominated warm slopes and ridges, and mesophytic forests dominated cool slopes. Chestnut oak and black oak occurred most frequently on soils developed from residuum, and American beech and hickories occurred on colluvial soils. It can be inferred that chestnut oak and black oak were common on upper slopes and ridges, and that American beech and hickories were common on mid and lower positions of long, steep slopes. Stands on cool aspects were denser than those on warm aspects, and, as expected, fire damage was greatest on warm aspects.

These studies have sought to identify and classify existing forest communities; i.e., typical descriptive botanical studies. Some investigators used correlation and/or multiple regression techniques to predict the importance of overstory and understory species to soil and topographic factors.

Rodriguez (1973) evaluated site quality of chestnut oak, white oak, and yellow-poplar at the Cumberland Forest Station, owned by the University of Tennessee, Scott County, Tenn. Elevation ranged from 1,400

study mentioned above are the only attempts to determine relative or absolute productivity of Cumberland Mountain forest sites other than on a regional basis (Birdsey 1983, Kingsley and Powell 1978, Knight and McClure 1978).

SUBREGIONS AND LANDTYPE ASSOCIATIONS

I have divided the Cumberland Mountain Region into three subregions: (1) strike ridges, (2) the block interior, Wartburg Basin, and Jellico Mountains, and (3) major river bottoms (fig. 2). These divisions are based on easily recognized topographic features as well as strong geologic differences. Subregions 1 and 2 were divided into four and three landtype associations (LTA's), respectively. Subregion 3 has only one landtype association. Landtype associations correspond closely to soil associations shown on general soil maps for Tennessee and Kentucky (Soil Conservation Service 1975, Springer and Elder 1980). Landtype associations in Virginia are based on a study of old county soil surveys, Lietz and Porter's (1978) interpretive guide, and personal knowledge of the area because the Cumberland Mountains are not differentiated from the Ridge and Valley physiographic province on the Virginia general soil map (Soil Conservation Service 1979) (table 3). A description of these landtype associations follows.

Subregion 1: Strike Ridges

Landtype Association-A: Walden Ridge, Fork Mountain, and Chestnut Ridge.—This LTA corresponds to a portion of soil association H21 (Boulders and Rock outcrop-Ramsey) in Tennessee and soil association 7 (Grimsley-Jefferson-Ramsey) in the Anderson

Table 3.—Subregions and landtype associations of the Cumberland Mountain region

Subregion	Landtype Association
1. Strike ridges	A. Walden Ridge, Fork Mountain, and Chestnut Ridge B. Pine Mountain C. Cumberland Stone

county, Tenn. soil survey (Moneymaker 1981). The LTA includes: (1) the narrow, monoclinical Walden Ridge extending northeast from Oliver Springs to Lake City, then northwest to Vasper, south of Caryville in Campbell County, and (2) the two prominent anticlinal ridges—Fork Mountain and Chestnut Ridge—that extend from Caryville to near Elk Gap and form the southwest side of the Pine Mountain thrust plate. Walden Ridge is the northern end of the much wider land mass of the same name designated as Subregion 2 of the Mid-Cumberland Plateau region (Smalley 1982). The south end of Fork Mountain is separated from Cumberland Mountain by Bruce Gap, through which Interstate Highway 75 passes. The north end of Chestnut Ridge merges with Pine Mountain near Hackle Knob.

Landtype Association-A represents the narrow ridge crests, the intermittent sandstone free face, and the steep colluvial slopes below the crest and free face. On the west side of Walden Ridge and both sides of Fork Mountain and Chestnut Ridge, rocks of the Pizzard and Crab Orchard formations rest against younger sandstones and shales of the Crooked Fork and Slatestone groups. On the east side of Walden Ridge, the escarpment cuts across Pennsylvanian sandstones and shales and Mississippian limestones.

The narrow, undulating ridge crests have steep, convex slopes which, in places, end abruptly at the intermittent sandstone free face or merge into long, nearly concave side slopes. The loamy, shallow to moderately deep, well-drained to somewhat excessively drained soils formed in residuum and surficial colluvium from acid sandstone and, in places, from shale and siltstones. The surface is usually strewn with sandstone fragments, and rock outcrops are common.

The escarpment consists of steep, linear to concave slopes with numerous rock ledges, boulders, and benches. These slopes extend from the sandstone free face or convex upper slopes to the adjacent valleys.

Soils on the west slopes of Walden Ridge and both sides of Fork Mountain and Chestnut Ridge are shallow to deep, loamy, well-drained, and contain varying amounts of rock fragments. The surface is strewn with sandstone cobbles and boulders. Soils formed in colluvium from the ridge crests and upper slopes. On east-facing lower slopes of Walden Ridge, the silty and clayey, flaggy soils are well-drained and derived from clayey residuum from limestone. Limestone

Association-B is included in soil association Kalb-Berks-Weikert) in Virginia.

Landtype Association-B represents the straight, narrow ridge crest; the weakly dissected northwest-facing scarp slope; and the strongly dissected southeast-facing back slope. The ridge crest is mostly narrow and very rocky, but discontinuous. In broader areas occur. The back slope is dissected by intermittent streams, resulting in a complex pattern of V-hollows, steep stony side slopes, and fairly steep sloping spur ridges. Although the dominant exposure is southeast, there are distinct cool and warm slopes, and some lower slopes are shaded by adjacent ridges. Nearly vertical pinnacles of resistant sandstone occur in places, mostly in Kentucky and Virginia; however, they are not as common as on the back slope of the Cumberland-Stone Mountain (LTA-C).

The loamy, well-drained to somewhat excessively drained soils on main and spur ridges are generally less than 40 in to bedrock and formed mostly in residuum from tilted strata of sandstone and some sandstone and shale. The steep back slope is covered by well-drained colluvial soils containing varying amounts of rock fragments. Stream channels are strewn with rocks.

The weakly dissected scarp slope is very steep. The sandstone free face occurs in places, but it is not continuous or as tall as the one surrounding the Cumberland Plateau (LTA-A) because the bedrock is thin. Minor free faces occur intermittently downslope. The resistant, thin strata of sandstone between thin layers of limestone and shale. The very steep upper half to two-thirds of the outslope is straight to slightly convex, and the sloping to moderately concave lower one-third to one-half is concave. Benches are narrow and extend only for short distances.

The deep, loamy soils on the scarp slope are well-drained and derived from limestone colluvium in the residuum. The soil mass contains considerable sandstone fragments and limestone outcrops in places.

Nearly all of LTA-B is forested. Some of the Mountain back slope between Pound Gap and Breaks Interstate Park is in the Clinch District of the Jefferson National Forest. Some benches and broad main and spur ridges have been cleared in times past but most have reverted to woodland. A few arroyo toe slopes are cleared and used for pasture and hay. Seven landtypes are recognized: 2 and 9 – 14.

Landtype Association-C: Cumberland-Stone

broader, higher Powell Mountain ringing the head of Powell Valley to the south (LTA-D).

Landtype Association-C represents the mostly narrow, undulating ridge crest; the weakly dissected southeast-facing scarp slope; and the strongly dissected northwest-facing back slope consisting of narrow to broad spur ridges, steep side slopes, and narrow V-shaped coves.

The ridge crest is mostly narrow and very rocky, but discontinuous broader areas are common. The back slope is well-dissected by intermittent streams, resulting in a complex pattern of V-hollows, steep side slopes, and fairly wide, sloping spur ridges. Nearly vertical pinnacles of resistant sandstone are common, more so than on the back slope of Pine Mountain (LTA-B). The loamy soils on the main and spur ridges are well-drained to somewhat excessively drained, are generally less than 40 in to bedrock, and are formed in residuum and local colluvium from dissected strata of sandstone and some siltstone and shale.

Hollows incised into the back slope of Cumberland-Stone Mountain are flanked with steep, stony side slopes. Although the dominant exposure is northwest, there are distinct cool and warm slopes, and some lower slopes are shaded by adjacent ridges. These steep slopes are covered with deep, well-drained, colluvial soils containing varying amounts of rock fragments. Stream channels are strewn with rocks.

The scarp slope is very steep and weakly dissected. The sandstone free face is prominent along nearly the entire length of Cumberland-Stone Mountain. However, this free face is not as continuous or as tall as the one ringing the Cumberland Plateau (LTA-A) because of the tilt of the bedrock. Minor free faces occur intermittently downslope on resistant, thin strata of sandstone between the thicker layers of limestone and shale. The very steep upper one-half to two-thirds of the scarp slope is straight or slightly convex, and the sloping to moderately steep lower one-third to one-half is concave. Benches are narrow and extend only for short distances.

The deep, well-drained loamy soils formed in sandstone colluvium and limestone residuum and colluvium. The soil mass contains considerable rock fragments, and outcrops of limestone occur in places. Nearly all of LTA-C is forested. Some benches and

the Pine Mountain thrust plate (LTA-F) is the Guadalupe River from Norton to Coeburn, thence southeast to its confluence with the Clinch River near Bangor, VA.

Topography of LTA-D ranges from high mountains consisting of narrow ridges, steep rocky slopes, and narrow V-valleys with 500 to 1,200 ft of local relief to lower mountains consisting of narrow broad undulating ridges, hilly to rolling side slopes, and broad V-valleys with 100 to 350 ft of local relief. Streams drain into the Powell, Clinch, and Guadalupe Rivers.

On the upper northwest-facing slope overlooking Powell Valley, the loamy soils are shallow to moderately deep, excessively drained, and quite stony. Further downslope, deep, well-drained, loamy soils have developed in colluvium. In places, limestone outcrops are interspersed with pockets of shallow to moderately deep clayey soils.

On narrow main and spur ridges, soils are loamy, well-drained to somewhat excessively drained, and are generally less than 40 in to bedrock. On broad ridges and gently sloping to hilly side slopes, soils are loamy, well-drained, and moderately deep to deep.

Hollows are flanked with hilly to steep, stony side slopes oriented in all directions. Local relief is enough to cause shading by adjacent land masses. Side slopes are covered with deep, well-drained colluvial soils containing varying amounts of rock fragments. In places, sandstone rubble occurs along the base of these steep slopes.

Upper reaches of mountain streams are V-shaped but further downstream narrow bottoms occur. The deep alluvial soils vary from loamy and well-drained to clayey and poorly-drained. The better-drained portions support gardens and subsistent farms of local residents. Sporadic rapid, high-volume flows transport gravel, cobbles, and boulders downstream.

Area surface mining of coal is common in LTA-F. Minespoil is composed of a mixture of partially weathered fine earth and fragments of acid shale, siltstone, coal, and sandstone. The young, loamy soils developing in minespoil are 35 to 80 percent rock and strongly to extremely acid unless limed. Soils are well-drained to excessively drained with moderately slow permeability; runoff is very rapid.

Nearly all of LTA-D is forested; some is in the Clinch District of the Jefferson National Forest. Some benches and smooth ridges were cleared, but

Landtype Association 1 (DeKalb-Berks-Weikert) in Virginia. The boundary between LTA's E and F is the Buck Knob anticline.

Landtype Association-E is characterized by high, rugged mountains such as Log, Black, and Little Back. Elevation ranges from 1,200 to nearly 4,200 ft, and relief ranges from 1,000 to 1,400 ft but approaches 2,500 ft near the highest peaks. Terrain consists of long, steep mountain slopes with gradients of 20 to 60 percent, narrow crests, and narrow winding valleys. Small areas of smooth land occur on mountain tops, footslopes, benches, and stream-bottoms. Middlesboro, Ky. is situated in a broad valley, and an area northeast of Middlesboro consists of low mountains of more gentle relief than most of the anticline.

The dominant bedrock is shale, but ledges of sandstone are common. Soils on ridge crests and convex upper slopes formed in residuum from shale and sandstone. One-third or more of LTA-E consists of soils formed in colluvium. On some mountain slopes, colluvium extends three-fourths of the way to the top, and in some places, goes through gaps and down the other slope.

A series of narrow benches and short sandstone cliffs occurs on some of the steepest slopes. Soils on mountain crests average 2 to 4 ft to rock; those on upper slopes average 1 to 3 ft; and those on colluvial slopes average 5 to 15 ft. These soils are mostly pale, loamy, and friable, with varying amounts of rock fragments. Soils with dark surface layers occur in places at higher elevations and in coves.

The narrow, winding valleys represent the majority of smooth land in LTA-E, and most of the sparse population live in these valleys. The alluvial soils are mostly deeper than 5 ft, pale, loamy, and friable. Rock fragments are common on the surface and throughout the profile of these valley soils.

Large tracts are owned by timber and coal companies. Contour and area surface mining of the extensive coal deposits has disturbed thousands of acres and resulted in the acidification and siltation of streams. Soils developing in minespoil contain 35 to 80 percent rock and coal fragments. These young soils are well-drained with moderately slow permeability; run-off is very rapid. Reaction ranges from neutral to extremely acid.

Nearly all of LTA-E is forested with a mixture of hardwoods and conifers. Species composition and

boundary between LTA-E and LTA-F is the Buck Knob anticline. Landtype Association-F is separated from Landtype Association-D by the Guest River.

Landtype Association-F is characterized by lower, less rugged mountains than those in LTA-E. The exception is Big A Mountain in the northeast corner of the LTA, which rises abruptly above the surrounding mountains to 3,735 ft. Elevation ranges from 1,500 to 3,200 ft, but most land lies below 2,600 ft. Local relief ranges from 100 to 600 ft. Terrain consists of winding, narrow to broad, rounded mountain crests; undulating to steep, moderately long slopes with gradients of 8 to 60 percent; and narrow winding valleys.

Bedrock is shale, sandstone, and numerous coal seams. Soils on ridge crests and convex upper slopes formed in residuum from sandstone and shale. Since, on the average, slopes are shorter than those in LTA-E, colluvial soils seldom extend more than two-thirds of the way to the ridge tops. Upwards of 10 percent of LTA-F consists of nearly level to sloping broad ridges that supported a moderately extensive farm economy consisting of apples, potatoes, berries, and other truck crops. Farming as a livelihood has declined considerably in the last decade or so.

A series of narrow benches and short sandstone cliffs occurs on some of the steepest slopes. Soils on mountain crests average 2 to 4 ft deep, those on upper slopes average 1 to 3 ft, and those on colluvial slopes are 5 to 15 ft. Soils are mostly pale, loamy, and friable, with varying amounts of rock fragments. Soils with dark surface layers occur at higher elevations on north aspects and in coves.

Alluvial soils in the narrow winding valleys are pale, loamy, friable, and mostly deeper than 5 ft. Rock fragments are common on the surface and throughout the profile of these valley soils.

Large tracts are owned by lumber and coal companies. Surface mining of coal has disturbed considerable acreage and resulted in the acidification and siltation of streams. Soils developing in minespoil contain 35 to 80 percent rock and coal fragments. The young soils are well-drained to excessively drained with moderately slow permeability; runoff is rapid. Reaction ranges from neutral to extremely acid.

Nearly all of LTA-F is forested with a mixture of hardwoods and conifers. Species composition and stand density vary greatly with aspect, slope position, and degree of shading from adjacent land masses.

ion H23 (Muskingum-Gilpin-Jefferson) in Tennessee and soil association G2 (Latham-Shelocta) in Kentucky. In the soil survey of the Whitley-McCreary area, Ky. (Byrne and others 1970), the Jellico Mountains were assigned to the Muse-Shelocta soil association. In the soil survey of Anderson County, Tenn. (Moneyemaker 1981), most of the Wartburg Basin was assigned to the Muskingum-Jefferson-Gilpin-Udorhents soil association. The highest peaks, corresponding approximately to the Red Oak Mountain, Powell Mountain, and Cross Mountain geologic formations, were assigned to the Muskingum-Udorhents-Petros soil association.

The highest peaks in LTA-G are in the eastern part of the Wartburg Basin, and elevation decreases gradually to the west where the Basin merges with the Mid-Cumberland Plateau (Smalley 1982). Elevation of the Jellico Mountains decreases to the north and east until these mountains merge with the Northern Cumberland Plateau. The northern boundary of LTA-G east of Williamsburg follows the Cumberland River, then turns south along Poplar Creek to the steep slope of Pine Mountain (LTA-B).

Landtype Association-G is characterized by high, rugged mountains consisting of narrow crests and long steep slopes often broken with narrow benches and short sandstone cliffs. Relief averages 1,800 ft in the Wartburg Basin, exceeds 2,000 ft near the highest peaks, and diminishes to 1,200 ft and less in the Jellico Mountains. Intermountain valleys are narrow and winding. Mountain slopes vary from 20 to 60 percent. Small areas of smooth land occur on mountain tops, benches, footslopes, and in streambottoms.

Bedrock is mostly shale and siltstone interspersed with relatively thin strata of sandstone. Soils on ridge crests and convex upper mountain slopes formed in residuum from sandstone and shale. Usually, ridges underlain by shale are more rounded than those underlain by sandstone. One-third or more of LTA-G consists of soils formed in colluvium. In places, colluvium extends three-fourths of the way to the top, and may fill gaps between high peaks.

Soils on mountain crests average 2 to 4 ft to rock, those on upper slopes average 1 to 3 ft, and those on alluvial slopes are 5 to 15 ft. Soils are mostly pale, clayey, and friable with varying amounts of shale and sandstone fragments. Soils with dark surface layers occur at higher elevations on north aspects and in

deposits has disturbed thousands of acres and resulted in the acidification and siltation of streams. Soils forming in minespoils contain 35 to 80 percent rock and coal fragments. These young soils are well drained to excessively drained with moderately slow permeability; runoff is very rapid. Reaction ranges from neutral to extremely acid.

Nearly all of LTA-G is forested with a mixture of hardwoods and conifers. Species composition and stand density vary greatly with aspect, slope position, and degree of shading from adjacent land masses. Eleven landtypes are recognized: 2 and 19–28.

Subregion 3: Major River Bottoms

Landtype Association-H: Cumberland River and Major Tributaries.—This LTA corresponds to soil association A8 (Pope-Bonnie-Allegheny) and A9 (Morehead-Whitley-Cuba) on the Kentucky General Soil Map. Soil association A8 occurs along the Cumberland River from the Whitley-McCreary County line east to Williamsburg and south along Clear Creek. Soil association A9 occurs along the Cumberland River upstream from Williamsburg nearly to Pineville. Landtype Association-H also corresponds to the Atkins-Pope-Tate soil association in the Whitley-McCreary-Whitley area soil survey (Byrne and others 1970). A soil survey in progress assigns the Cumberland River bottom in the eastern half of Whitley County and Knox County, Ky. to an Allegheny-Huntington-Newark soil association.² Another survey in progress assigns Elk Valley and the lower reaches of Elk Creek in Tennessee to an Atkins-Whitley-Eastern soil association, an extension of Kentucky general soil association A8.³

Landtype Association-H is a continuation of LTA-M in the Eastern Highland Rim and Pennyroyal Region (Smalley 1983) and LTA-L in the Western Highland Rim and Pennyroyal Region (Smalley 1980).

Landtype Association-H consists of well-drained to somewhat poorly drained, loamy and silty soils formed in old mixed alluvium on terraces, and well drained to poorly drained silty soils formed in more recent mixed alluvium on flood plains.

These bottoms vary from broad extensive areas nearly a mile wide to narrow discontinuous strips less than 1,000 ft wide. Flood plains are nearly level

footslopes are steeper and relief may exceed 100

LANDTYPES

fluctuating water tables and occasional flooding at the use of this LTA and affect the management of the land. Most of the bottoms of the Cumberland River and its major tributaries have been cleared for agriculture, but woodlands, some extensive, are scattered along these rivers. Some land has been tile-drained to make it suitable for cultivation. Corn, small grains, beans, and legumes and tall grasses for hay and pasture are major crops.

Two landtypes are recognized: 29 and 30. Bottoms of smaller rivers, creeks, and streams in the Cumberland Mountains are assigned to Landtypes 19 and 20.

I have divided each landtype association into landtypes, which are the smallest unit of the landscape recognized in this classification system. Wertz and Arnold (1975) describe landtypes as visually identifiable areas that have similar soils and productivity and that have resulted from similar climatic and geological processes.

The Cumberland Mountains region has 30 landtypes distributed among three subregions and eight landtype associations (table 4). Many are common to two or more associations, while others are characteristic of only one landtype association. Figures 3 to 5

Table 4.—*Summary of landtypes and their occurrence by subregions and landtype associations*

Landtype number and name by subregion	Landtype association ¹
1. Strike ridges	
1. Narrow sandstone ridges and convex upper slopes	A, D
2. Shallow soils and sandstone outcrops	A, B, C, D
3. Broad sandstone ridges—north aspect	A, D
4. Broad sandstone ridges—south aspect	A, D
5. Upper sandstone talus slopes and benches—north aspect	A
6. Upper sandstone talus slopes and benches—south aspect	A
7. Lower limestone slopes, benches, and spur ridges—north aspect	A
8. Lower limestone slopes, benches, and spur ridges—south aspect	A
9. Shallow soils and limestone outcrops	A, B, C, D
10. Overthrust ridge crests and spur ridges on back slopes	B, C
11. Upper back slope (southeast) of Pine Mountain	B
12. Lower back slope (southeast) of Pine Mountain	B
13. Upper scarp slope (northwest) of Pine and Stone-Powell Mountains	B, D
14. Lower scarp slope (northwest) of Pine and Stone-Powell Mountains	B, D
15. Upper back slope (northwest) of Cumberland-Stone Mountain	C
16. Lower back slope (northwest) of Cumberland-Stone Mountain	C
17. Upper scarp slope (southeast) of Cumberland-Stone Mountain	C
18. Upper scarp slope (southeast) of Cumberland-Stone Mountain	C
21. Undulating sandstone mountain uplands	D
22. Upper mountain slopes—north aspect	D
23. Upper mountain slopes—south aspect	D
24. Colluvial mountain slopes, benches, and coves—north aspect	D
25. Colluvial mountain slopes, benches, and coves—south aspect	D
26. Surface mines	D
2. Thrust block interior, Wartburg Basin, and Jellico Mountains	
2. Shallow soils and sandstone outcrops	E, F, G
3. Broad sandstone ridges—north aspect	E, F
4. Broad sandstone ridges—south aspect	E, F
19. Mountain footslopes, fans, terraces, and streambottoms with good drainage	E, F, G
20. Mountain terraces and streambottoms with poor drainage	E, F, G
21. Undulating sandstone mountain uplands	E, F, G
22. Upper mountain slopes—north aspect	E, F, G
23. Upper mountain slopes—south aspect	E, F, G

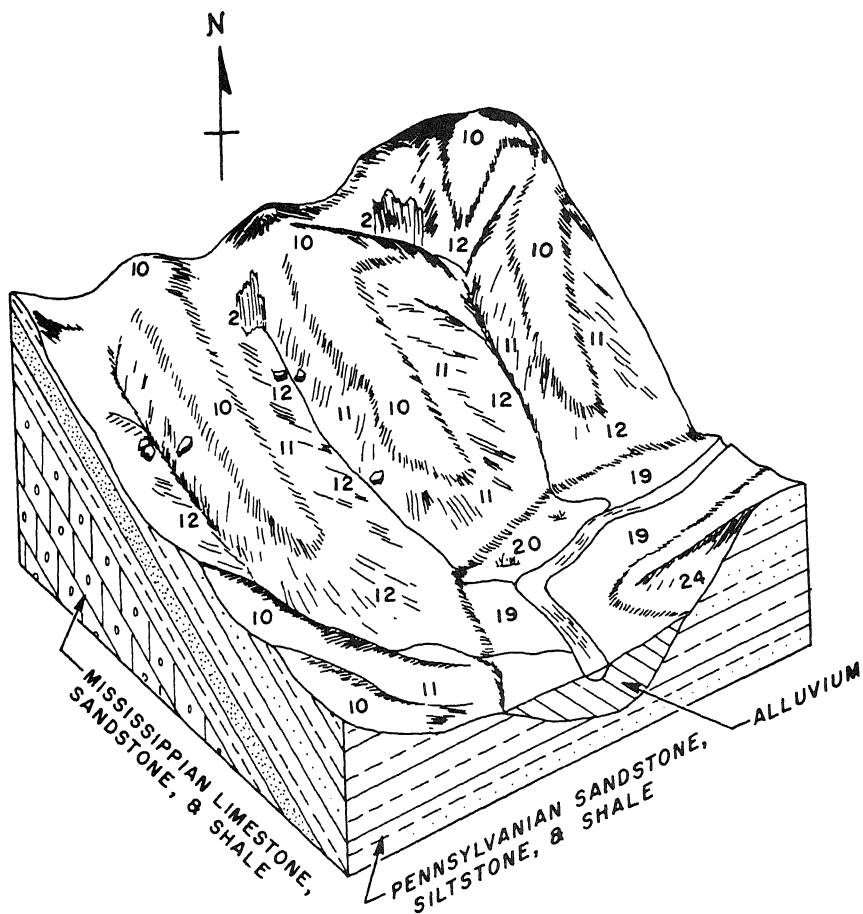


Figure 3.—Landtypes characteristic of Landtype Association B (Pine Mountain) in Subregion 1 and the junction with Landtype Associations E (Middlesboro syncline) and F (Pine Mountain thrust plate syncline) in Subregion 2. The mirror image of figure 3 would represent Landtype Association C (Cumberland-Stone Mountain). Landtypes 15, 16, and 25 would correspond respectively to Landtypes 11, 12, and 24.

LEGEND

- 2. Shallow soils and sandstone outcrops.
- 10. Overthrust ridge crests and spur ridges on back slopes.

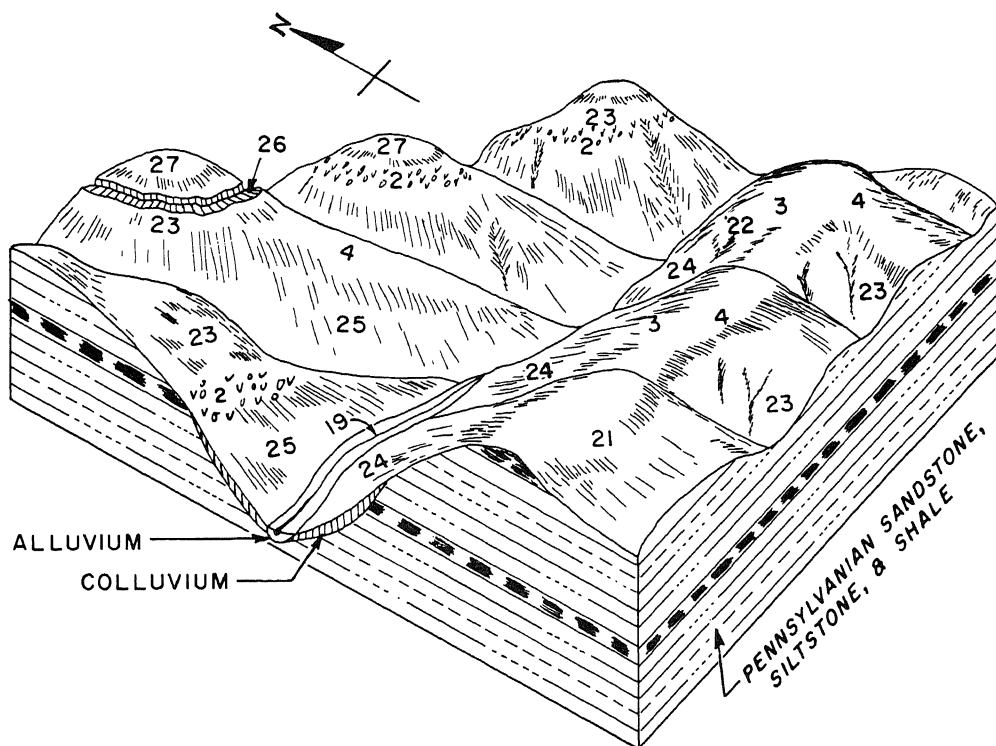


Figure 4.—Landtypes characteristic of Landtype Association F (Pine Mountain thrust plate syncline) in Subregion 2. Adapted from figures 3 and 4 in McDonald and Blevins (1965).

LEGEND

2. Shallow soils and sandstone outcrops.
3. Broad sandstone ridges—north aspect.
4. Broad sandstone ridges—south aspect.
10. Mountain front slopes, forested, and bottom with sand dunes.

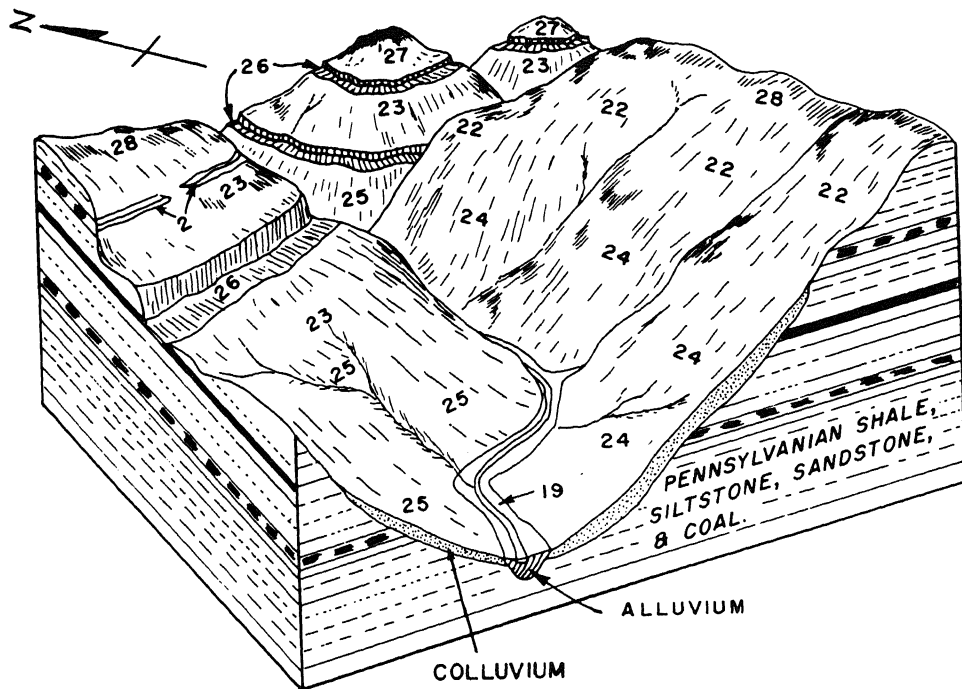


Figure 5.—Landtypes characteristic of Landtype Association E (Middlesboro syncline) and G (Wartburg Basin-Jellico Mountains) in Subregion 2. Adapted from figure 1 in Knight (1979).

LEGEND

2 Shallow soils and sandstone outcrops

dict how these landtypes occur on the landscape in A's-B, E, F, and G.

Letters in the upper right corner of each landtype description (See "Landtype Descriptions and Forest Management Interpretations") identify the landtype association(s) in which each landtype occurs. Aspect distinguishes some landtypes and is recorded as either north or south. North aspects include all azimuths from 315° (northwest) to 135° (southeast). The remainder of the azimuth circle represents south aspects.

Each landtype is described in terms of nine elements in "Landtype Descriptions and Forest Management Interpretations." The **Geographic Setting** provides an overall description of the landtype, specifying both where it occurs on the landscape and its relation to other landtypes. Slope was classified in accordance with SCS standards (Soil Survey Staff 1951).

Slope Classes and Corresponding Percent of Slope

Slope percent	Class
0 - 2	Level or nearly level
2 - 6	Gently sloping
6 - 10	Sloping
10 - 15	Strongly sloping
15 - 25	Moderately steep
25 - 45	Steep
45 +	Very steep

The most prevalent soil series are listed under **Dominant Soils**. The series link this site classification system with county soil surveys published by SCS. Readers who wish more detailed information can refer to the published surveys or to soil series descriptions issued by SCS.

The kind of **Bedrock** or **Soil Parent Material** and **Depth to Bedrock** are listed next. **Soil Texture** is described in terms of the 12 conventional classes, which are based on percentages of sand, silt, and clay (Soil Survey Staff 1951).

The conventional seven **Soil Drainage** classes are: *very poorly drained, poorly drained, somewhat poorly drained, moderately well-drained, well-drained, somewhat excessively drained, and excessively drained* (Soil Survey Staff 1951). **Relative Soil Water Supply** for each landtype is rated in five classes: *very low, low, medium high, and very high*. This qualitative rating

quently, the most fertile soils of the Cumberland Mountain region are rated only moderate, except those along mountain streams and the Cumberland River, which are rated moderately high to high.

The most common woody species in the overstory are listed under **Vegetation** in approximate order of abundance. Important understory species are listed also, including some distinctive herbaceous groups. Although not listed, reproduction of overstory species is usually present in the understory. Loblolly pine is native only in northern Alabama and southern Tennessee but has been planted north of its range on converted sites and abandoned fields. Species nomenclature follows Little (1979) and Fernald (1950).

FOREST MANAGEMENT INTERPRETATIONS

Each landtype is evaluated in terms of productivity for selected species of trees and species desirability for timber production (tables 5 - 34). Also, each landtype is rated for five soil-related problems that may affect forest management operations.

Productivity

Productivity of commercially valuable species is expressed as site index and as average annual growth in cubic feet per acre. Site index is the total height attained by dominant and codominant trees at specified age.

For all naturally occurring species, site indices are the means of values from soil survey interpretations for dominant soils in each landtype. Interpretations are issued by SCS as part of each soil series description. SCS personnel obtained height and age measurements in well-stocked, even-aged, essentially unmanaged stands that had not been damaged excessively by fire, insects, disease, or grazing. These stands were located on soils representing, as nearly as possible, the modal concept of each soil series. SCS personnel then used published site index curves (Beck 1937, Broadfoot and Krinard 1959, Curtis and Post 1959, Defler 1937, Nelson and others 1961, Schnur 1959, Tennessee Valley Authority 1948¹, and U.S. Forest Service 1929) to convert height and age data to site indices. Curves for all species were based on age 50 years. Sometimes, when site indices were available for one species, estimates for other species were made

In a few cases when no values were available, site indices of important species were estimated; where they occur in tables 5 - 34, these estimated values are enclosed in parentheses.

Average annual growth expressed in cubic feet per acre was calculated from available yield tables (McCarthy 1933, Nelson and others 1961, Schnur 1937, U.S. Forest Service 1929, and Winters and Osborne 1935). The yield tables represent either normal or fully stocked conditions. Annual growth rates for all naturally occurring species or forest types were averaged over 50 years.

Though our productivity data are the best available, all site curves and yield tables were developed either for geographic areas larger than but including the Cumberland Mountains or for areas that do not include the Cumberland Mountains.

Yields are not expressed in a common merchantability standard, so care should be exercised in comparing average annual yields of species both within and between landtypes. Footnotes to table 5, which apply to subsequent tables, specify the merchantability standards used.

Management Problems

Plant Competition rates the invasion of unwanted plants after openings are made in the canopy. Plant competition is *slight* if unwanted plants do not prevent adequate natural regeneration, interfere with early growth, or restrict normal development of unwanted or seeded seedlings. Competition is *moderate* if unwanted plants delay establishment and hinder the growth of regenerated seedlings or if they retard the eventual development of a fully stocked stand. Competition is *severe* if unwanted plants prevent adequate restocking without extensive site preparation or special maintenance practices. Competition ratings in tables 5 - 34 represent regional averages, and competition on a given landtype may vary as a result of past land use.

Seedling Mortality is the loss of artificially established tree seedlings as influenced by soils and topographic conditions, assuming that planting is done properly and plant competition is insignificant. Rating is *slight* if expected mortality is zero to 25 percent, *moderate* if expected mortality is 26 to 50 per-

cent, restricting the season when equipment is used. Generally, limitation is *slight* if slope is 20 percent or less and farm machinery can operate efficiently during seasons. The rating is *moderate* if slope 20 to 30 percent, limiting the use of ordinary farm machinery and requiring track-type equipment, or if soil wetness prevents the use of logging vehicles for 2 to 6 months in a year. The rating *severe* if slope exceeds 30 percent, making track-type equipment inadequate and requiring power vehicles and other special equipment or if wetness prevents use of vehicles for 6 months or more in a year.

Erosion Hazard is the degree of potential soil erosion that can occur during and after forest management operations that expose soil along roads, skid trails, fire lanes, and landing areas. The rating assumes that the forest is well-managed and protected from fire and grazing. Soil and topographic characteristics considered in rating hazard of erosion include slope, infiltration, permeability, water-holding capacity, and resistance to detachment of soil particles by rainfall and runoff. *Slight* indicates that no special measures are needed, *moderate* indicates that some attention needs to be given to erosion control, and *severe* indicates that intensive erosion-control measures are needed.

Windthrow Hazard measures how soils affect root development and how firmly soils hold trees. The hazard is *slight* if rooting depth is more than 20 inches and trees withstand most winds, *moderate* if effective rooting depth is 10 to 20 inches and some trees are blown down during excessive soil wetness and strong winds, and *severe* if effective rooting depth is 10 inches or less and trees will not stand alone in strong winds.

Species Desirability

Three categories are used for rating **Species Desirability** of species that commonly occur on each landtype. *Most Desirable* species are those with potential for fast growth, high value, or both. *Acceptable* species are those with moderate growth rate or value. *Least Desirable* species are those with slow growth, poor quality, or both. These ratings represent the average situation for the region. The presence or absence of local markets could result in a species being assigned to another category.

site-dependent framework for forest management planning and forest research.

To make on-site determinations of productivity on a particular tract of land, the user must first determine the subregion and landtype association in which the particular tract of land occurs by referring to table 3 and fig. 2. Landtypes common to each landtype association are shown in table 4. Landtype descriptions and landscape drawings (figs. 3–5) will enable the user to identify specific landtypes. Information about productivity, severity of management problems, and species desirability are shown on pages facing the landtype descriptions (tables 5–34).

This site classification system provides a sound biological basis for forest management planning because it recognizes inherent site differences and soil-related hazards. When the system is adopted, landtypes become the basic unit of management. Continuous Forest Inventory or other forest inventory systems can easily be incorporated into this site classification system to obtain information on acreage, stocking, composition, and growth of forests by landtypes. Once productivity data are available for landtypes on a specific tract, they should be substituted for the regional values in the appropriate tables.

Users should be aware that productivity will vary within a landtype. This variation should be handled as a sampling problem dependent on the desired precision of the productivity information. To adequately sample some landtypes, users with existing inventory systems may be required to install new plots or points. Excessive variation in productivity within a landtype may indicate the need to divide that landtype into more homogeneous units.

A logical vehicle to transfer this site classification system into a valuable forest management tool is a

landtype map (fig. 6), which can be used for a range of management, from day-to-day acreage to long-range planning. The number and scale of maps will depend on size of ownership and how much land the owner wishes to manage. Landtypes can be mapped at scales of 1:10,000 to 1:60,000 and smaller areas as small as 2 acres can be represented on larger scale maps. Smoothness of terrain will determine maximum size. So the 7½ minute quadrangle sheets are excellent base maps on which to delineate landtypes. Black and white or color aerial photographs and stereo pairs, can also serve as base maps. A considerable amount of ground checking should be done in the mapping process. Owners or managers of land should explore the advantages of conducting a mapping of landtypes and other physical features of the landscape (Beemarlund 1981). For forest researchers, this site classification system provides a basis for stratifying land for study. The system also aids in identifying and prioritizing problems that need to be researched. It became apparent in compiling site information that little mensuration information for the region are available. Finally, the system provides researchers with a vehicle for communicating research results to the practitioner. Site information should be reported on the basis of their appropriate specific landtypes.

An insight into multiple-use evaluation was found in a paper by Trimble and others (1981) on the Central Appalachians, the northern Cumberland Plateau and Mountains. This paper has summarized the knowledge on forest management, forestry and wildlife management in the southern wood region. Vogel (1981) has provided some basic guidelines for revegetating mine

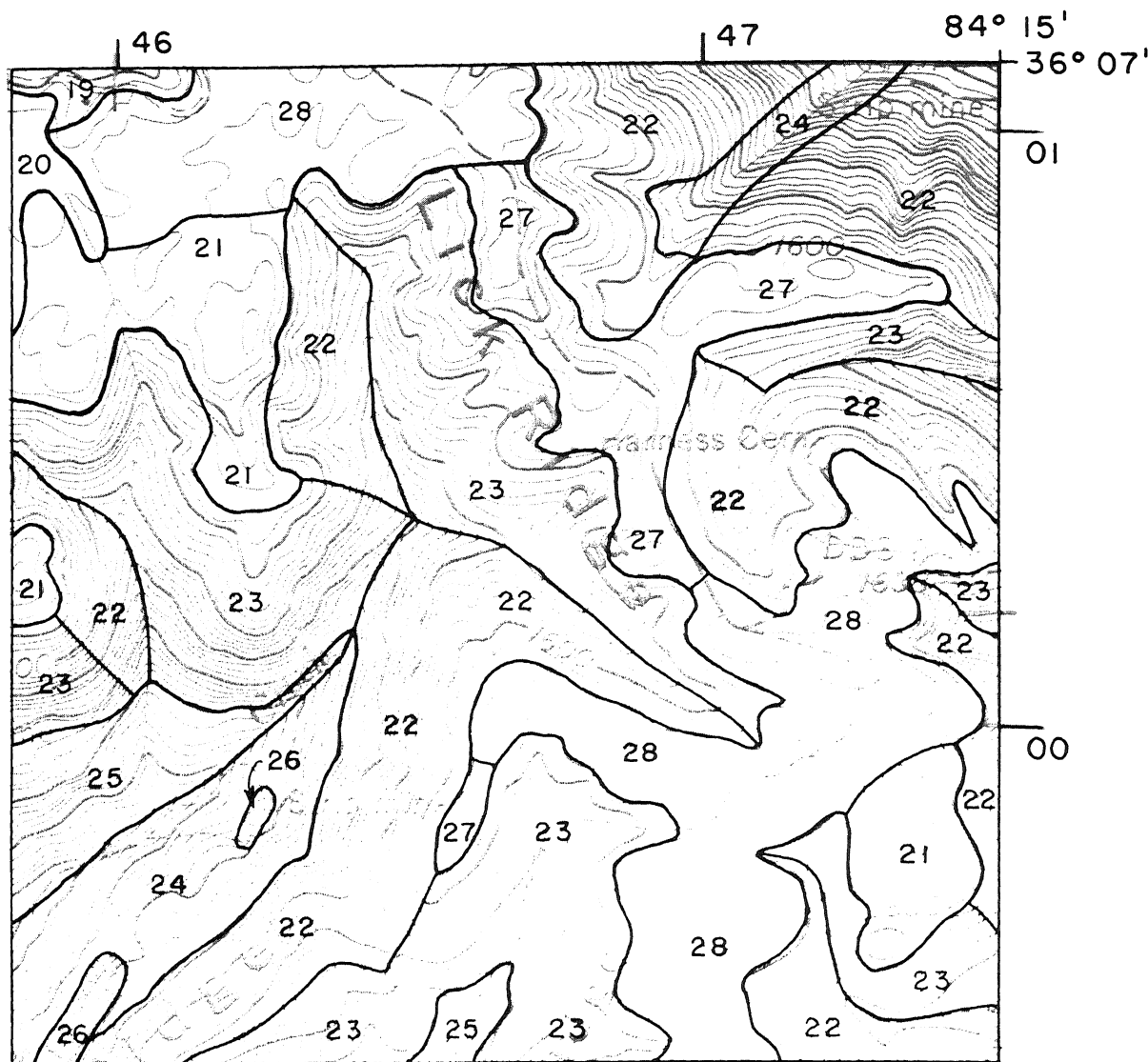


Figure 6.—A sample landtype map showing Landtype Association G (Wartburg Basin and Jellico Mountains) in Subregion 2. Map covers a tract of about 700 acres in the northeast corner of the northwest quarter of the Windrock Quadrangle, Anderson County, Tenn. Scale is 1:12,000. See table 4 for a list of landtypes and their associated soil series. (Map by M. J. Anderson, U.S. Forest Service, Asheville, N.C.)

LANDTYPE DESCRIPTIONS AND FOREST MANAGEMENT INTERPRETATIONS

Description of Landtype 1: Narrow Sandstone Ridges and Convex Upper Slopes

Geographic Setting—Shallow to moderately deep soils on gently sloping to steep, straight to winding, narrow ridgetops and adjoining convex upper slopes in Subregions 1 and 2. Slope ranges from 5 to 40 percent. Typically, these ridgetops are less than 300 ft wide. Soils formed mostly in loamy residuum from horizontally bedded sandstone. Outcrops of sandstone and rock fragments on the surface are common and, in places, extensive enough to recognize Landtype 2 (shallow soils and sandstone outcrops). In LTA-A, Landtype 1 occupies the crests of the Walden Ridge, Fork Mountain, and Chestnut Ridge in association with Landtypes 3 and 4. Landtypes 5 and 6 occur below Landtype 1. In LTA-D, Landtype 1 occupies the main and spur ridges of Powell Mountain in association with Landtypes 3, 4, and 21. Landtypes 22 and 23 usually occupy the steep upper slopes below Landtype 1.

Dominant Soils—Ramsey, Alticrest, Wallen, and Steinsburg; possibly Lily, Muskingum, and Dekalb.

Bedrock—Nearly horizontal acid sandstone, conglomerate, and quartzite with thin strata of siltstone and shale in places.

Depth to Bedrock—7 to 40 in.

Texture—Loam, sandy loam, fine sandy loam; occasionally silty loam. Often gravelly, stony, or channery. Rock fragment content usually does not exceed 35 percent in the solum, except Wallen soils may have up to 70 percent rock fragments in the B horizon.

Soil Drainage—Well-drained to somewhat excessively drained.

Relative Soil Water Supply—Low.

Soil Fertility—Low.

Vegetation—Chestnut oak, scarlet oak, post oak, hickories, black oak, white oak, red maple, Virginia pine, and southern red oak; occasional shortleaf pine, blackjack oak, eastern white pine, eastern redcedar, and blackgum. Sassafras, sourwood, flowering dogwood, vacciniums, sumac, persimmon, Carolina buckthorn, mountain-laurel, and

Table 5.—*Forest management interpretations for Landtype 1: Narrow sandstone ridges and convex upper slopes*

PRODUCTIVITY				
Species		Site index ¹	Average annual growth ² (ft ³ /acre)	
E. white pine		70	115	
Shortleaf pine		60	102	
Virginia pine		65	70	
White oak		60	43	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Slight to moderate	Moderate to severe	Moderate to severe	Slight to severe	Moderate to severe
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
E. white pine	Hickories			E. redcedar
Shortleaf pine	Post oak			Blackjack oak
Virginia pine	Chestnut oak			Sassafras
Black oak	Scarlet oak			American holly
White oak				Red maple
S. red oak				Blackgum
				Flowering dogwood
				Sourwood
				Persimmon

¹ Site indices in tables 5 – 34 for each naturally occurring species, except those enclosed in parentheses, are the means of values from soil survey interpretations issued by SCS for the dominant soils in each landtype, but sometimes adjusted for aspect and slope position (Beck 1962, Broadfoot and Krinard 1959, Curtis and Post 1962, Defler 1937, Nelson and others 1961, Schnur 1937, and U.S. Forest Service 1929). Estimated site indices are enclosed in parentheses. Base age is 50 years for all naturally grown species.

² Annual growth of natural stands calculated from published yields at 50 years: Shortleaf pine (U.S. Forest Service 1929, table 108), total volume outside-bark, trees > 3.5-in d.b.h.; Virginia pine (Nelson and others 1961, table 4), outside-bark volume to a 4.0-in o.b. top, trees > 3.5-in d.b.h.; Upland oaks (Schnur 1937, table 2, column 12), outside-bark volume 4.0-in o.b. top, trees > 4.5-in d.b.h.; Yellow-poplar (McCarthy 1933, table 17), inside-bark volume to 3.0-in i.b. top, trees > 4.5-in d.b.h.; Sweetgum (Winters and Osborne 1935, table 13), inside-bark volume to a 4.0-in i.b. top, trees > 4.5-in d.b.h.

Description of Landtype 2: Shallow Soils and Sandstone Outcrops

Geographic Setting—Small to moderately large areas of exposed sandstone, conglomerate, and quartzite and shallow to moderately deep, loamy soils formed in residuum from these same rocks in Subregions 1 and 2. Slope ranges from 8 to 70 percent. The area of exposed rock varies from a few square feet to several acres mostly in narrow strips. Slope of the rock is nearly level in LTA's A, D, E, F, and G, but is tilted, sometimes near vertical, in LTA's B and C. Landtype 2 occurs on nearly level to moderately steep ridgetops, slopes, and edges of Walden Ridge, Fork Mountain, and Chestnut Ridge (LTA-A) above the nearly vertical sandstone free face in association with Landtypes 1, 3, and 4. Landtype 2 occurs on hilly to very steep crests and spur ridges of Pine, Cumberland, Stone, and Powell Mountains (LTA's B, C, and D) in association with Landtypes 1, 3, 4, 10, 11, 13, 15, and 17. Landtype 2 represents the thin to moderately thick sandstone free faces that occur intermittently on steep mountain slopes in LTA's E, F, and G in association with Landtypes 22-25. Landtype 2 also occurs extensively along deeply incised streams and creeks throughout Subregion 2.

Dominant Soils—Ramsey and sandstone outcrops; possibly Wallen, Alticrest, Dekalb, and Steinsburg.

Bedrock—Sandstone, conglomerate, and quartzite.

Depth to Bedrock—Usually less than 20 in, but occasionally ranges up to 40 in in places.

Texture—Loam, sandy loam, and fine sandy loam; often stony. Rock fragment content is usually less than 35 percent, but is more in places. Amount and size of fragments usually increase with depth.

Soil Drainage—Well-drained to somewhat excessively drained.

Relative Soil Water Supply—Very low. Seepage above exposed rock is common in wet weather, but the soil dries quickly.

Soil Fertility—Very low.

Vegetation—Chestnut oak, white oak, post oak, blackjack oak, scarlet oak, southern red oak, and blackgum; occasional Virginia pine, shortleaf pine, pitch pine, hickories, red maple, and eastern redcedar. Sourwood, flowering dogwood, winged elm, mountain-laurel, vacciniums, lichens, mosses.

Table 6.—*Forest management interpretations for Landtype 2: Shallow soils and sandstone outcrops*

PRODUCTIVITY				
Species	Site index ¹		Average annual growth ² (ft ³ /acre)	
Shortleaf pine	50		79	
Virginia pine	55		41	
E. redcedar	30			
White oak	55		32	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Slight	Moderate to severe	Slight to severe	Slight to severe	Severe
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
Shortleaf pine	Pitch pine			Blackjack oak
Virginia pine	E. redcedar			Winged elm
	Hickories			Red maple
	White oak			Blackgum
	Post oak			Flowering dogwood
	Chestnut oak			Sourwood
	S. red oak			
	Scarlet oak			

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 3: Broad Sandstone Ridges— North Aspect

Geographic Setting—Moderately deep, loamy soils on gently sloping to moderately steep north-facing portions of broad ridgetops and adjoining convex upper slopes in Subregions 1 and 2. This landtype extends from the ridge crest down to where the slope becomes linear or nearly so. At this point, gradient usually increases noticeably. Slope ranges from 6 to 20 percent and is dominantly greater than 10 percent. Soils formed in loamy residuum from sandstone or from interbedded sandstone, siltstone and shale. Rock fragments occur on the surface in places. Landtype 3 is associated with Landtype 1 in LTA's A, D, and F. In LTA-E, it occupies the ridgetops of lower mountains such as those northeast of Middlesboro, Ky. Landtype 3 also occurs in association with Landtype 21 in LTA's D, E, and F, and occasionally with Landtypes 27 and 28 in LTA's E and F. Landtype 3 lies above the sandstone free face in LTA-A and above Landtype 27 in LTA's D, E, and F. Landtype 3 may grade into Landtypes 19 or 20 in the heads of hollows in LTA's E and F.

Dominant Soils—Lily, Alticrest, Wallen, and Steinsburg; possibly Muskingum and Dekalb. Wallen soils are more common on south and west aspects.

Bedrock—Sandstone and conglomerate with thin strata of shale and siltstone in places.

Depth to Bedrock—20 to 40 in.

Texture—Loam, fine sandy loam, and sandy loam; occasionally silt loam and sometimes gravelly, stony, or flaggy. Volume of sandstone, and in places shale fragments, in the solum is usually less than 35 percent, but deeper horizons may contain more.

Soil Drainage—Well-drained to somewhat excessively drained.

Relative Soil Water Supply—Medium.

Soil Fertility—Moderately low.

Vegetation—White oak, scarlet oak, southern red oak, chestnut oak, hickories, black oak, blackgum, red maple, shortleaf pine, Virginia pine, and eastern white pine; occasional yellow-poplar, northern red oak, black cherry, black locust, post oak, white ash, and eastern redcedar. Flowering dogwood, sassafras, serviceberry, sourwood, persimmon, sumac, viburnums, vacciniums, azaleas, smilax,

Table 7.—*Forest management interpretations for Landtype 3: Broad sandstone ridges—north aspect*

PRODUCTIVITY				
Species	Site index ¹		Average annual growth ² (ft ³ /acre)	
E. white pine	75		126	
Shortleaf pine	65		113	
Virginia pine	65		120	
N. red oak	70		52	
Yellow-poplar	95		98	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Moderate	Slight to moderate	Slight to moderate	Slight to moderate	Slight to moderate
SPECIES DESIRABILITY				
Most desirable	Acceptable		Least desirable	
E. white pine	Hickories		E. redcedar	
Shortleaf pine	White oak		Sassafras	
Virginia pine	Post oak		Serviceberry	
Yellow-poplar	Chestnut oak		Black locust	
	N. red oak		American holly	
	Black oak		Red maple	
	S. red oak		Blackgum	
	Scarlet oak		Flowering dogwood	
	Black cherry		Sourwood	
	White ash		Persimmon	

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 4: Broad Sandstone Ridges— South Aspect

Geographic Setting—Moderately deep, loamy soils on gently sloping to moderately steep south-facing portions of broad ridgetops and adjoining convex upper slopes in Subregions 1 and 2. This landtype extends from the ridge crest down to where the slope becomes linear or nearly so. At this point, gradient usually increases noticeably. Slope ranges from 6 to 20 percent and is dominantly greater than 10 percent. Soils formed in loamy residuum from sandstone or from interbedded sandstone, siltstone, and shale. Rock fragments occur on the surface in places. Landtype 4 is associated with Landtype 1 in LTA's A, D, and F. In LTA-E, it occupies the ridgetops of lower mountains such as those northeast of Middlesboro, Ky. Landtype 4 also occurs in association with Landtype 21 in LTA's D, E, and F and occasionally with Landtypes 27 and 28 in LTA's E and F. Landtype 4 lies above the sandstone free face in LTA-A and above Landtype 23 in LTA's D, E, and F. Landtype 3 may grade into Landtype 19 or 20 in the heads of hollows in LTA's E and F.

Dominant Soils—Lily, Alticrest, Wallen, and Steinsburg; possibly Muskingum and Dekalb. Wallen soils are more common on south and west aspects.

Bedrock—Sandstone and conglomerate with thin strata of shale and siltstone in places.

Depth to Bedrock—20 to 40 in.

Texture—Loam, fine sandy loam, and sandy loam; occasionally silt loam and sometimes gravelly, stony, or flaggy. Volume of sandstone, and in places shale fragments, in the solum is usually less than 35 percent, but deeper horizons may contain more.

Soil Drainage—Well-drained to somewhat excessively drained.

Relative Soil Water Supply—Medium to low.

Soil Fertility—Moderately low.

Vegetation—White oak, scarlet oak, chestnut oak, southern red oak, hickories, black oak, post oak, blackgum, red maple, Virginia pine, and shortleaf pine; occasional black locust, eastern redcedar, eastern white pine, and yellow-poplar. Dogwoods, sassafras, sourwood, persimmon, vacciniums, sumac, viburnums, serviceberry, mountain-laurel,

Table 8.—*Forest management interpretations for Landtype 4: Broad sandstone ridges—south aspect*

PRODUCTIVITY				
Species	Site index ¹		Average annual growth ² (ft ³ /acre)	
L. white pine	70		115	
Shortleaf pine	60		102	
Virginia pine	60		53	
L. red oak	65		48	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Moderate	Slight to moderate	Slight to moderate	Slight	Slight to moderate
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
L. white pine	Hickories			E. redcedar
Shortleaf pine	White oak			Post oak
Virginia pine	Chestnut oak			Sassafras
	Black oak			Serviceberry
	S. red oak			Black locust
	Scarlet oak			Red maple
				Blackgum
				Dogwoods
				Sourwood
				Persimmon

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 5: Upper Sandstone Talus Slopes and Benches—North Aspect

Geographic Setting—Deep to very deep, loamy soils formed in colluvium from sandstone, siltstone, and shale and underlain by sandstone, siltstone, or shale in Subregion 1. Landtype 5 occupies the gently sloping to very steep upper one-third to one-half of the north-facing escarpment that extends from the free face to the adjacent valleys. Slope ranges from 5 to 70 percent, and much of the surface is covered with sandstone boulders and fragments. This landtype may be absent if the free face extends down to limestone. Landtype 5 is a mesic site and has high productivity.

Dominant Soils—Grimsley and Jefferson. Formerly mapped as sandstone rockland or bouldery colluvial land.

Bedrock—Sandstone, siltstone, and shale.

Depth to Bedrock—40 to 60 in or more.

Texture—Gravelly or cobbly loam, silt loam, sandy clay loam, or clay loam.

Soil Drainage—Well-drained.

Relative Soil Water Supply—Very high to high. Irrigated by subsurface flow and seepage.

Soil Fertility—Moderate to moderately low.

Vegetation—White oak, northern red oak, yellow-poplar, chestnut oak, sugar maple, hickories, American beech, black oak, white ash, white basswood, yellow buckeye, red maple, and black locust; occasional blackgum, elms, southern red oak, eastern hemlock, eastern white pine, chinkapin oak, black cherry, black walnut, and cucumbertree. Flowering dogwood, eastern redbud, bigleaf magnolia, spicebush, bladdernut, hydrangea, viburnums, azaleas, rhododendrons, sourwood, grape, and pawpaw are common understory species. This landtype also supports a rich herbaceous flora.

Table 9.—*Forest management interpretations for Landtype 5: Upper sandstone talus slopes and benches—north aspect*

PRODUCTIVITY				
Species	Site index ¹		Average annual growth ² (ft ³ /acre)	
Black walnut	(90)		57 – 62	
White oak	75			
N. red oak	80			
S. red oak	75			
Yellow-poplar	100		107	
Black cherry	(90)			
White ash	(90)			
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Moderate	Slight	Slight to severe	Slight to moderate	Slight
SPECIES DESIRABILITY				
Most desirable	Acceptable		Least desirable	
Black walnut	E. white pine		E. hemlock	
White oak	Chinkapin oak		American beech	
N. red oak	Black oak		E. redbud	
Yellow-poplar	S. red oak		Black locust	
Black cherry	Elms		Red maple	
White ash	Cucumbertree		Blackgum	
	Sugar maple		Flowering dogwood	
	Yellow buckeye		Sourwood	
	White basswood			

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 6: Upper Sandstone Talus Slope and Benches—South Aspect

Geographic Setting—Deep to very deep, loamy soils formed in colluvium from sandstone, siltstone, and shale and underlain by sandstone, siltstone, or shale in Subregion 1. Landtype 6 occupies the gently sloping to very steep upper one-third to one-half of the south-facing escarpment that extends from the free face to the adjacent valleys. Slope ranges from 5 to 70 percent. Much of the surface is covered with sandstone boulders and fragments. This landtype may be absent if the free face extends down to limestone. Landtype 6 is not as productive as Landtype 5, and forests lack the preponderance of mesic species found on north aspects.

Dominant Soils—Grimsley and Jefferson. Formerly mapped as sandstone rockland or bouldery colluvial land.

Bedrock—Sandstone, siltstone, and shale.

Depth to Bedrock—40 to 60 in or more.

Texture—Gravelly or cobbly loam, silt loam, sandy clay loam, or clay loam.

Soil Drainage—Well-drained.

Relative Soil Water Supply—Medium to low. Irrigated by subsurface flow and seepage. This landtype is not as moist as Landtype 5.

Soil Fertility—Moderate to moderately low.

Vegetation—White oak, chestnut oak, northern red oak, hickories, black oak, red maple, yellow-poplar, and black locust; occasional blackgum, elms, eastern white pine, white ash, black cherry, black walnut, sugar maple, southern red oak, shortleaf pine, Virginia pine, and American beech. Flowering dogwood, viburnums, eastern redbud, sourwood, azaleas, and grape are common understory species.

Table 10.—*Forest management interpretations for Landtype 6: Upper sandstone talus slopes and benches—south aspect*

PRODUCTIVITY				
Species		Site index ¹	Average annual growth ² (ft ³ /acre)	
Shortleaf pine		65	113	
Virginia pine		70	92	
White oak		(65)	43 – 48	
N. red oak		60		
S. red oak		(65)		
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Slight	Moderate	Slight to severe	Slight to moderate	Slight
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
E. white pine	Black walnut			American beech
Shortleaf pine	Hickories			E. redbud
Virginia pine	Black locust			Red maple
White oak	N. red oak			Blackgum
Chestnut oak	Elms			Dogwood
Black oak	Yellow poplar			Sourwood
S. red oak	Black cherry			
	Sugar maple			
	White ash			

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 7: Lower Limestone Slopes, Benches, and Spur Ridges—North Aspect

Geographic Setting—Moderately deep to very deep, loamy and clayey soils formed in colluvium from sandstone, siltstone, and shale and from limestone residuum and underlain by limestone in Subregion 1. Landtype 7 occupies the gently sloping to very steep lower one-half to two-thirds of the north-facing escarpment that extends from the free face to the adjacent valleys or the entire northern slopes of narrow spur ridges that extend into the adjacent valleys. Slope ranges from 2 to 75 percent. Sandstone boulders may be present, but up to 40 percent of the surface is covered with outcrops of limestone. Soil material between the rocks is compact, sticky, heavy clay. Coarse fragments in the soil vary from less than 10 percent to 65 percent. This landtype usually occurs downslope from Landtype 5 and is less productive than north upper talus slopes. Landtype 9 often occurs in association with Landtype 7 or below it on footslopes dominated by limestone outcrops. Where the free face has developed down to limestone, however, this landtype extends from the base of the escarpment down to the adjoining valleys.

Dominant Soils—Bouldin, Allen, Nella, and Talbott. Formerly mapped as limestone rockland or bouldery colluvial land.

Bedrock—Limestone.

Depth to Bedrock—Mostly 60 in or more but may be 20 to 40 in where Talbott soils occur.

Texture—Cobbly to stony loam, sandy loam, clay loam, and silt loam.

Soil Drainage—Well-drained.

Relative Soil Water Supply—Medium to low. Soil water percolates deep into the limestone.

Soil Fertility—Moderate to moderately low.

Vegetation—White oak, chestnut oak, northern red oak, black oak, hickories, eastern redcedar, scarlet oak, southern red oak, red maple, and yellow-poplar; occasional blackgum, sugar maple, eastern white pine, post oak, chinkapin oak, and elms. Flowering dogwood, eastern redbud, winged elm,

Table 11.—*Forest management interpretations for Landtype 7: Lower limestone slopes, benches, and spur ridges—north aspect*

PRODUCTIVITY				
Species	Site index ¹		Average annual growth ² (ft ³ /acre)	
White oak	70	}	43 – 52	
N. red oak	70			
S. red oak	60			
Yellow-poplar	85		80	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Slight to moderate	Slight to moderate	Slight to severe	Slight to moderate	Slight to moderate
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
White oak	E. white pine			Ironwood
N. red oak	E. redcedar			Winged elm
Black oak	Hickories			E. redbud
S. red oak	Post oak			Red maple
Yellow-poplar	Chestnut oak			Blackgum
	Chinkapin oak			Flowering dogwood
	Scarlet oak			
	Elms			
	Sugar maple			

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 8: Lower Limestone Slopes, Benches, and Spur Ridges—South Aspect

Geographic Setting—Moderately deep to very deep, loamy and clayey soils formed in colluvium from sandstone, siltstone, and shale and from limestone residuum and underlain by limestone in Subregion 1. Landtype 8 occupies the gently sloping to very steep lower one-half to two-thirds of the south-facing escarpment that extends from the free face to the adjacent valleys or the entire southern slopes of narrow spur ridges that extend into the adjacent valleys. Slope ranges from 2 to 75 percent. Sandstone boulders may be present, but up to 40 percent of the surface is covered with outcrops of limestone. Soil material between the rocks is compact, sticky, heavy clay. Coarse fragments in the soil vary from less than 10 percent to 65 percent. This landtype usually occurs downslope from Landtype 6. Landtype 9 often occurs in association with Landtype 8 or below it on footslopes dominated by limestone outcrops. Where the free face has developed down to limestone, however, this landtype may extend from the base of the escarpment down to the adjoining valleys.

Dominant Soils—Bouldin, Allen, Nella, and Talbott. Formerly mapped as limestone rockland or bouldery colluvial land.

Bedrock—Limestone.

Depth to Bedrock—Mostly 60 in or more but may be 20 to 40 in where Talbott soils occur.

Texture—Cobbly to stony loam, sandy loam, clay loam, and silt loam.

Soil Drainage—Well-drained.

Relative Soil Water Supply—Low to very low. Soil water percolates deep into the limestone.

Soil Fertility—Moderate to moderately low.

Vegetation—White oak, scarlet oak, chestnut oak, hickories, eastern redcedar, white ash, post oak, southern red oak, black oak, red maple, and elms; occasional blackgum, black locust, chinkapin oak, honeylocust, blue ash, American beech, Virginia pine, and shortleaf pine. Eastern redbud, flowering dogwood, winged elms, viburnums, ironwood,

Table 12.—*Forest management interpretations for Landtype 8: Lower limestone slopes, benches, and spur ridges—south aspect*

PRODUCTIVITY				
Species	Site index ¹	Average annual growth ² (ft ³ /acre)		
Shortleaf pine	55	90		
Virginia pine	60	53		
E. redcedar	45	32 – 38		
White oak	50 }			
S. red oak	55 }			
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Slight	Moderate to severe	Moderate to severe	Slight to moderate	Slight to moderate
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
Shortleaf pine	E. redcedar			Ironwood
Virginia pine	Hickories			American beech
White oak	Post oak			Winged elm
S. red oak	Chestnut oak			E. redbud
White ash	Chinkapin oak			Honeylocust
	Black oak			Red maple
	Scarlet oak			Blackgum
	Elms			Flowering dogwood
	Black locust			
	Blue ash			

See footnotes 1 and 2 to table 5, p. 23.

Occurs in LTA's—A, B, C, and D

Description of Landtype 9: Shallow Soils and Limestone Outcrops

Geographic Setting—Small to extensive areas of limestone outcrops interspersed with patches of shallow to moderately deep, clayey soils on gently sloping to steep slopes of strike ridges in Subregion 1. Slope ranges from 2 to 40 percent. The soil mass may contain up to 65 percent limestone slabs, and more than 50 percent of the surface may be exposed limestone. Where the exposed rock is extensive, it is often terraced, but the slope of each terrace is nearly horizontal. Eastern redcedar often dominates this landtype. In LTA-A, this intricate pattern of soil and rock outcrops occurs mostly between Landtypes 7 and 8 and the adjacent valleys, but it may occur intermingled with these landtypes. Also, Landtype 9 occurs intermittently, on the upper scarp slope (northwest) of Pine and Stone-Powell Mountains (Landtype 13) in LTA's B and D and on the lower scarp slope (southeast) of Cumberland-Stone Mountain (Landtype 18) in LTA-C.

Dominant Soils—Barfield, Gladeville, and limestone rockland. Pockets of moderately deep Talbott may occur in this landtype.

Bedrock—Limestone.

Depth to Bedrock—Mostly less than 20 in but ranges up to 40 in where Talbott soils occur.

Texture—Silty clay loam, silty clay, clay, and silt loam.

Soil Drainage—Well-drained to excessively drained.

Relative Soil Water Supply—Low seepage is common in wet weather, but the soil dries quickly.

Soil Fertility—Moderate.

Vegetation—Eastern redcedar, hickories, hackberry, white ash, and elms; occasional honeylocust, Virginia pine, blackjack oak, blue ash, black walnut, southern red oak, chinkapin oak, and osage-orange. Forbs, grasses, sumac, eastern redbud, winged elm, buckthorn, hawthorn, and pricklypear are common in the understory.

Table 13.—*Forest management interpretations for Landtype 9: Shallow soils and limestone outcrops*

PRODUCTIVITY				
Species		Site index ¹	Average annual growth ² (ft ³ /acre)	
Virginia pine		(55)	41	
E. redcedar		40		
Upland oaks		(55)	38	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Slight	Severe	Moderate to severe	Moderate	Moderate to severe
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
Virginia pine	Hickories			Blackjack oak
E. redcedar	Chinkapin oak			Winged elm
Black walnut	Elms			Hackberry
S. red oak	White ash			Osage-orange
	Blue ash			E. redbud
				Honeylocust

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 10: Overthrust Ridge Crests and Spur Ridges on Back Slopes

Geographic Setting—Shallow to moderately deep, loamy soils on gently sloping to steep, narrow to moderately broad, nearly straight crests of Pine and Cumberland-Stone Mountains and spur ridges on backslopes (northwest side of Cumberland-Stone Mountain and southeast side of Pine Mountain) in Subregion 1. Slope ranges from 3 to 40 percent. Typically, these crests and spurs are less than 300 ft wide but may be wider in places. Soils formed in loamy residuum from tilted, sometimes nearly vertical, strata of sandstone, siltstone, and shale. Outcrops of sandstone and rock fragments on the surface are common and, in places, extensive enough to recognize Landtype 2. Landtype 10 is more extensive on Cumberland-Stone Mountain, where the crest is supported by fairly thick Pennsylvanian rocks. It is less common on Pine Mountain where Lower Pennsylvanian rocks are thin and the crest is supported mostly by Upper Mississippian strata. Landtype 10 occurs above Landtypes 11 and 15 on the back slopes of Pine and Cumberland-Stone Mountains, respectively, and above Landtypes 13 and 17 on the scarp slopes of Pine and Cumberland-Stone Mountains, respectively. Landtype 10 is a poor site because of topographic position, soil depth, and exposure to drying winds. No distinction is made at this time between cool and warm spur ridges.

Dominant Soils—Ramsey, Wallen, Alticrest, and Steinsburg; possibly Lily, Muskingum and Dekalb.

Bedrock—Tilted sandstone and conglomerate with thin strata of siltstone and shale in places.

Depth to Bedrock—7 to 40 in.

Texture—Loam, sandy loam, fine sandy loam, and silt loam. Often gravelly or stony. Rock fragment content in the solum is usually less than 35 percent, but deeper horizons may contain as much as 70 percent.

Soil Drainage—Well-drained to somewhat excessively drained.

Relative Soil Water Supply—Low.

Soil Fertility—Low.

Vegetation—Chestnut oak, white oak, scarlet oak, post oak, shortleaf pine, pitch pine, red maple, and hickories; occasional blackjack oak, blackgum, black oak, sourwood, Virginia pine, and eastern redcedar. Mountain-laurel, sumac, vacciniums,

Table 14.—*Forest management interpretations for Landtype 10: Overthrust ridge crests and spur ridges on back slopes*

PRODUCTIVITY				
Species		Site index ¹	Average annual growth ² (ft ³ /acre)	
E. white pine		70	126	
Shortleaf pine		60	102	
Virginia pine		65	70	
White oak		60	43	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Slight to moderate	Moderate to severe	Slight to severe	Slight to severe	Moderate to severe
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
Shortleaf pine	Pitch pine			Blackjack oak
Virginia pine	E. redcedar			Red maple
White oak	Hickories			Blackgum
	Chestnut oak			Sourwood
	Post oak			
	Scarlet oak			
	Black oak			

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 11: Upper Back Slope (Southeast) of Pine Mountain

Geographic Setting—Shallow to moderately deep, loamy soils on the moderately steep to very steep, upper one-fourth to one-half of the back slope (southeast side) of Pine Mountain in Subregion 1. Pinnacles and outcrops of sandstone are common but not as common as on Cumberland-Stone Mountain (Landtype 15). The convex to linear slopes range from 15 to 70 percent. Soils formed in loamy residuum from tilted, in places nearly vertical, strata of sandstone, siltstone, and shale. In places, outcrops of sandstone and rock fragments on the surface may be extensive enough to recognize Landtype 2. Landtype 11 occurs below Landtype 10 and above Landtype 12. Landtype 11 is a relatively dry site because of topographic position, soil depth, and exposure.

Dominant Soils—Ramsey, Wallen, Alticrest, and Steinsburg; possibly Muskingum and Dekalb.

Bedrock—Tilted sandstone and conglomerate with thin strata of siltstone and shale.

Depth to Bedrock—7 to 40 in.

Texture—Loam, sandy loam, and fine sandy loam; often gravelly or stony. Rock fragment content in the solum is usually less than 35 percent, but deeper horizons contain more.

Soil Drainage—Well-drained to somewhat excessively drained.

Relative Soil Water Supply—Low.

Soil Fertility—Low.

Vegetation—Chestnut oak, white oak, scarlet oak, post oak, shortleaf pine, Virginia pine, pitch pine, and hickories; occasional blackjack oak, blackgum, black oak, red maple, sourwood, eastern redcedar, and eastern white pine. Mountain-laurel, sumac, vacciniums, grasses, and forbs are common understory species.

Table 15.—*Forest management interpretations for Landtype 11: Upper back slope (southeast) of Pine Mountain*

PRODUCTIVITY				
Species	Site index ¹		Average annual growth ² (ft ³ /acre)	
white pine	70		126	
shortleaf pine	60		102	
Virginia pine	65		70	
white oak	60		43	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Slight	Moderate to severe	Moderate to severe	Moderate to severe	Moderate to severe
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
white pine	Pitch pine			Blackjack oak
shortleaf pine	E. redcedar			Red maple
Virginia pine	Hickories			Blackgum
white oak	Chestnut oak			Sourwood
	Post oak			
	Scarlet oak			
	Black oak			

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 12: Lower Back Slope (Southeast) of Pine Mountain

Geographic Setting—Deep, loamy, cobbly soils on the sloping to steep, lower one-half to three-fourths of the back slope (southeast side) of Pine Mountain in Subregion 1. Outcrops and pinnacles of sandstone are common and often delineate the spur ridges from the slopes. The linear to concave slopes range from 10 to 60 percent. Soils formed in colluvium from acid sandstone, conglomerate, siltstone, and shale. Sandstone cobbles and boulders are common on the surface in lower slope concavities and in stream channels. Landtype 12 occurs below Landtypes 10 and 11. These colluvial slopes surround the coves incised in the back slope of Pine Mountain. Stream gradients are steep, and the slopes extend to the rock-strewn stream channels. These coves merge with mountain stream terraces and bottoms (Landtypes 19 and 20).

Dominant Soils—Jefferson, Grimsley, Shelocta, and Rigley. Formerly mapped as bouldery colluvial land.

Bedrock—Tilted sandstone and conglomerate with thin strata of siltstone and shale.

Depth to Bedrock—40 to 120 in.

Texture—Cobbly or gravelly loam, fine sandy loam, sandy loam, and possibly silt loam. Rock fragment content in the solum is usually less than 35 percent but may range to 80 percent in lower horizons.

Soil Drainage—Well-drained.

Relative Soil Water Supply—High to very high. Irrigated by subsurface flow and seepage.

Soil Fertility—Moderate to moderately low.

Vegetation—Eastern hemlock, American beech, yellow-poplar, red maple, and white oak; occasional white basswood, northern red oak, yellow birch, sweet birch, blackgum, cucumbertree, Fraser magnolia, hickories, and chestnut oak. Bigleaf magnolia, umbrella magnolia, sourwood, flowering dogwood, American holly, and rhododendron are common understory species.

Table 16.—*Forest management interpretations for Landtype 12: Lower back slope (southeast) of Pine Mountain*

PRODUCTIVITY				
Species		Site index ¹	Average annual growth ² (ft ³ /acre)	
W. white pine		80	172	
Upland oaks		65 – 70	48 – 52	
Yellow-poplar		90	90	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Moderate	Slight to moderate	Moderate to severe	Moderate to severe	Slight
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
Hickories	E. hemlock			Magnolias
White oak	Yellow birch			American holly
Chestnut oak	Sweet birch			Red maple
W. red oak	American beech			Blackgum
Yellow-poplar	Cucumbertree			Flowering dogwood
	White basswood			Sourwood
				Rhododendron

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 13: Upper Scarp Slope (Northwest) of Pine and Stone-Powell Mountains

Geographic Setting—Shallow to moderately deep, clayey soils on moderately steep to very steep, upper one-fourth to one-half of the scarp slope (northwest side) of Pine and Stone-Powell Mountains in Subregion 1. Outcrops of limestone and sandstone ledges are common and, in places, may be extensive enough to recognize Landtype 9 or 2. The mostly linear slopes range from 30 to 65 percent. Soils formed in mostly clayey residuum from tilted limestone of the Mississippian Pennington Formation and, in places, tongues of sandstone of the Pennsylvanian Lee Formation. Landtype 13 occurs above Landtype 14 and below Landtype 10 or extends to the crest of Pine Mountain where the Lee Formation is thin or lacking and the Pennington Formation underlies the crest.

Dominant Soils—Talbot mesic variant and possibly Fairmount interspersed with limestone outcrops and sandstone ledges.

Bedrock—Tilted limestone with thin strata of shale and sandstone.

Depth to Bedrock—40 in or less.

Texture—Silt loam; occasional silty clay loam or silty clay. Rock fragment content is less than 35 percent in all horizons.

Soil Drainage—Well-drained.

Relative Soil Water Supply—Low to medium.

Soil Fertility—Moderate.

Vegetation—Sugar maple, white basswood, yellow-poplar, American beech, yellow buckeye, and white oak; occasional northern red oak, white ash, cucumbertree, hickories, red maple, black walnut, blackgum, chestnut oak, shortleaf pine, and Virginia pine. Flowering dogwood, sumac, viburnums, sassafras, eastern redbud, hydrangea, yellowwood, and eastern hophornbeam are common understory species.

Table 17.—*Forest management interpretations for Landtype 13: Upper scarp slope (northwest) of Pine and Stone-Powell Mountains*

PRODUCTIVITY				
Species		Site index ¹	Average annual growth ² (ft ³ /acre)	
Shortleaf pine		65	113	
Virginia pine		65	70	
L. red oak		65	48	
Yellow-poplar		90	90	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Moderate	Moderate	Moderate to severe	Moderate to severe	Slight to moderate
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
Black walnut	Shortleaf pine			E. hophornbeam
White oak	Virginia pine			Sassafras
L. red oak	Hickories			E. redbud
Yellow-poplar	American beech			Yellowwood
Sugar maple	Chestnut oak			Sumac
White ash	Cucumbertree			Red maple
	Yellow buckeye			Blackgum
	White basswood			Flowering dogwood

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 14: Lower Scarp Slope (Northwest) of Pine and Stone-Powell Mountains

Geographic Setting—Moderately deep to deep, loamy and clayey soils on the gently sloping to steep, lower one-half to three-fourths of the scarp slope (northwest side) of Pine Mountain in Subregion 1. The linear to concave slopes range from 8 to 50 percent. Soils formed mostly in colluvium—some places in residuum—from tilted limestone and thin strata of siltstone, and sandstone. Landtype 14 occurs below Landtype 13 (upper scarp (northwest) slope of Pine Mountain). The boundary between these two Landtypes is usually a distinct reduction in slope gradient. Also included in Landtype 14 are minor spur ridges and benches. Drainages on the northwest side of Pine Mountain are poorly defined, and no landtype is recognized for these incipient coves. No distinction is made of the occasional warmer slopes flanking spur ridges. Landtype 14 is a cool, moist site because of topographic position, soil depth, and exposure.

Dominant Soils—Bouldin, Jefferson, and Grimsley; possibly Renox and Talbott. Formerly mapped as stony or bouldery colluvial land.

Bedrock—Tilted limestone with thin strata of shale and sandstone.

Depth to Bedrock—Mostly 60 in or more but 20 to 40 in where Talbott occurs.

Texture—Cobbly, stony, or gravelly loam and sandy loam; occasionally silt loam.

Soil Drainage—Well-drained.

Relative Soil Water Supply—Medium. Some soil water may percolate into fractures and bedding planes in the tilted bedrock.

Soil Fertility—Moderate to moderately low.

Vegetation—Sugar maple, white basswood, yellow buckeye, and yellow-poplar; occasional white ash, northern red oak, cucumbertree, American beech, hickories, white oak, black walnut, blackgum, red maple, and eastern hemlock. Sassafras, yellowwood, umbrella magnolia, rhododendron, flowering dogwood, and eastern hophornbeam are common understory species. Landtype supports a luxuriant herbaceous layer.

Table 18.—*Forest management interpretations for Landtype 14: Lower scarp slope (northwest) of Pine and Stone-Powell Mountains*

PRODUCTIVITY				
Species		Site index ¹	Average annual growth ² (ft ³ /acre)	
White oak		70	52	
Red oak		75	57	
Yellow-poplar		100	107	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Slight to moderate	Slight to moderate	Moderate to severe	Slight to moderate	Slight
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
Black walnut	E. hemlock			E. hophornbeam
White oak	Hickories			Umbrella magnolia
Red oak	American beech			Sassafras
Yellow-poplar	Cucumbertree			Yellowwood
Sugar maple	Yellow buckeye			Red maple
White ash	White basswood			Blackgum
				Flowering dogwood

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 15: Upper Back Slope (Northwest) of Cumberland-Stone Mountain

Geographic Setting—Shallow to moderately deep, loamy soils on the moderately steep to very steep, upper one-third to one-half of the back slope (northwest side) of Cumberland-Stone Mountain in Subregion 1. Pinnacles and outcrops of sandstone are common, more so than on Pine Mountain (Landtype 11). The convex to linear slopes range from 15 to 70 percent. Soils formed in loamy residuum from tilted, in places nearly vertical, strata of sandstone, siltstone, and shale. Outcrops of sandstone and rock fragments on the surface may be extensive enough to recognize Landtype 2. Landtype 15 occurs below Landtype 10 and above Landtype 16, and is a somewhat more mesic site than the comparable southeast-facing back slope on Pine Mountain (Landtype 11).

Dominant Soils—Ramsey, Wallen, Alticrest, and Steinsburg; possibly Muskingum and Dekalb.

Bedrock—Tilted sandstone and conglomerate with thin strata of siltstone and shale.

Depth to Bedrock—7 to 40 in.

Texture—Loam, sandy loam, and fine sandy loam; often gravelly or stony. Rock fragment content in the solum is usually less than 35 percent, but deeper horizons contain more.

Soil Drainage—Well-drained to somewhat excessively drained.

Relative Soil Water Supply—Low.

Soil Fertility—Low.

Vegetation—Chestnut oak, white oak, scarlet oak, shortleaf pine, pitch pine, and hickories; occasional eastern white pine, black oak, post oak, Virginia pine, blackgum, northern red oak, red maple, yellow-poplar, and American beech. Flowering dogwood, sumac, vacciniums, sassafras, viburnums, grasses, and forbs are common understory species.

Table 19.—*Forest management interpretations for Landtype 15: Upper back slope (northwest) of Cumberland-Stone Mountain*

PRODUCTIVITY				
Species		Site index ¹	Average annual growth (ft ³ /acre)	
E. white pine		(75)	126	
Shortleaf pine		60	102	
Virginia pine		65	70	
Upland oaks		(60 – 65)	(43 – 48)	
Yellow-poplar		(80)	71	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Slight to moderate	Moderate	Moderate to severe	Moderate to severe	Moderate to severe
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
E. white pine	Pitch pine			Sassafras
Shortleaf pine	Hickories			Sumac
Virginia pine	American beech			Red maple
White oak	Post oak			Blackgum
N. red oak	Chestnut oak			Flowering dogwo
Yellow-poplar	Black oak			
	Scarlet oak			

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 16: Lower Back Slope (Northwest) of Cumberland-Stone Mountain

Geographic Setting—Deep, loamy, cobbly soils on the sloping to steep, lower one-half to two-thirds of the back slope (northwest side) of Cumberland-Stone Mountain in Subregion 1. Outcrops and pinnacles of sandstone are common and often delineate the spur ridges from the slopes. The linear to concave slopes range from 10 to 60 percent. Soils formed in colluvium from acid sandstone, conglomerate, siltstone, and shale. Sandstone cobbles and boulders are common on the surface, on lower slope concavities, and in stream channels. Landtype 16 occurs below Landtypes 10 and 15. These colluvial slopes surround the coves incised into the back slope of Cumberland-Stone Mountain. Stream gradients are steep, and the slopes extend to the rock-strewn stream channels. These coves merge with mountain stream terraces and bottoms (Landtypes 19 and 20). Landtype 16 is a cool, moist site; it is cooler and moister than its southeast-facing counterpart (Landtype 12) on Pine Mountain.

Dominant Soils—Jefferson, Grimsley, Shelocta, and Rigley. Formerly mapped as bouldery colluvial land.

Bedrock—Tilted sandstone and conglomerate with thin strata of siltstone and shale.

Depth to Bedrock—40 to 120 in.

Texture—Cobbly or gravelly loam, fine sandy loam, sandy loam, and possibly silt loam. Rock fragment content in the solum is usually less than 35 percent but may range to 80 percent in lower horizons.

Soil Drainage—Well-drained.

Relative Soil Water Supply—High to very high. Irrigated by subsurface flow and seepage.

Soil Fertility—Moderate to moderately low.

Vegetation—Eastern hemlock, American beech, yellow-poplar, red maple, and white oak; occasional white basswood, northern red oak, eastern white pine, yellow birch, sweet birch, blackgum, cucumber tree, Fraser magnolia, hickories, and chestnut oak. Bigleaf magnolia, umbrella magnolia, sourwood, flowering dogwood, American holly, and rhododendron are common understory species.

Table 20.—*Forest management interpretations for Landtype 16: Lower back slope (northwest) of Cumberland-Stone Mountain*

PRODUCTIVITY				
Species		Site index ¹	Average annual growth ² (ft ³ /acre)	
E. white pine		90	154	
Upland oaks		70 – 75	52 – 57	
Yellow-poplar		100	107	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Moderate to severe	Slight	Moderate to severe	Moderate to severe	Slight
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
E. white pine	E. hemlock			Magnolias
Hickories	Yellow birch			American holly
White oak	Sweet birch			Red maple
N. red oak	American beech			Blackgum
Yellow-poplar	Chestnut oak			Flowering dogwood
	Cucumbertree			Sourwood
	White basswood			

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 17: Upper Scarp Slope (Southeast) of Cumberland-Stone Mountain

Geographic Setting—Shallow to moderately deep, loamy soils on moderately steep to very steep, upper one-fourth to one-half of the scarp slope (southeast side) of Cumberland-Stone Mountain in Subregion 1. In places, prominent free faces have developed on resistant strata of sandstone and conglomerate. Boulders are common on the surface below the free faces. Outcrops may be extensive enough to recognize Landtype 2. The mostly linear slopes range from 30 to 65 percent. Soils formed in loamy residuum from tilted, in places nearly vertical, strata of sandstone, conglomerate, siltstone, and shale. Landtype 17 occurs below Landtype 10 and above Landtype 18.

Dominant Soils—Ramsey, Wallen, Alticrest, and Steinsburg; possibly Muskingum and Dekalb.

Bedrock—Tilted sandstone and conglomerate with thin strata of siltstone and shale.

Depth to Bedrock—7 to 40 in.

Texture—Loam, sandy loam, and fine sandy loam; often gravelly or stony. Coarse fragment content in the solum is usually less than 35 percent, but deeper horizons contain more.

Soil Drainage—Well-drained to somewhat excessively drained.

Relative Soil Water Supply—Low.

Soil Fertility—Low.

Vegetation—Chestnut oak, white oak, scarlet oak, post oak, shortleaf pine, pitch pine, and hickories; occasional blackjack oak, blackgum, black oak, red maple, sourwood, eastern redcedar, Virginia pine, and eastern white pine. Mountain-laurel, sumac, vacciniums, grasses, and forbs are common understory species.

Table 21.—*Forest management interpretations for Landtype 17: Upper scarp slope (southeast) of Cumberland-Stone Mountain*

PRODUCTIVITY				
Species		Site index ¹	Average annual growth (ft ³ /acre)	
E. white pine		70	115	
Shortleaf pine		60	102	
Virginia pine		65	70	
White oak		60	43	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Slight	Moderate to severe	Moderate to severe	Moderate to severe	Moderate to severe
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
E. white pine	Pitch pine			Blackjack oak
Shortleaf pine	E. redcedar			Red maple
Virginia pine	Chestnut oak			Blackgum
White oak	Post oak			Sourwood
	Scarlet oak			
	Black oak			

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 18: Lower Scarp Slope (Southeast) of Cumberland-Stone Mountain

Geographic Setting—Moderately deep to deep, loamy and clayey soils on the gently sloping to steep, lower one-half to three-fourths of the scarp slope (southeast side) of Cumberland-Stone Mountain in Subregion 1. The linear to concave slopes range from 8 to 50 percent. Soils formed mostly in colluvium—in some places in residuum—from tilted limestone and thin strata of siltstone, and sandstone. Landtype 18 occurs below Landtype 17. The boundary between these two Landtypes is usually a distinct reduction in slope gradient. Also included in Landtype 18 are minor spur ridges and benches. Drainages on the southeast side of Cumberland-Stone Mountain are poorly defined, and no landtype is recognized for these incipient coves. Also, no distinction is made of the occasional cooler slopes flanking spur ridges. Landtype 18 is a much warmer site than its counterpart (Landtype 14) on Pine Mountain.

Dominant Soils—Bouldin, Jefferson, and Grimsley; possibly Allen, Nella, and Talbott. Formerly mapped as stony or bouldery colluvial land.

Bedrock—Tilted limestone with thin strata of shale and sandstone.

Depth to Bedrock—Mostly deeper than 4 ft but 20 to 40 in where Talbott occurs.

Texture—Cobbly, stony, or gravelly loam and sandy loam; occasionally silt loam.

Soil Drainage—Well-drained.

Relative Soil Water Supply—Medium. Some soil water may percolate into fractures and bedding planes in the tilted bedrock.

Soil Fertility—Moderate to moderately low.

Vegetation—Chestnut oak, black oak, white oak, hickories, shortleaf pine, and Virginia pine; occasional American beech, red maple, northern red oak, blackgum, eastern redcedar, black locust, southern red oak, yellow-poplar, eastern hemlock, black walnut, and sourwood. Flowering dogwood, sumac, Carolina buckthorn, American holly, and rhododendron are common understory species.

Table 22.—*Forest management interpretations for Landtype 18: Lower scarp slope (southeast) of Cumberland-Stone Mountain*

PRODUCTIVITY				
Species		Site index ¹	Average annual growth (ft ³ /acre)	
Shortleaf pine		65	113	
Virginia pine		70	92	
E. redcedar		60		
White oak		70	52	
N. red oak				
S. red oak				
Yellow-poplar		(85)	80	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Moderate	Slight to moderate	Moderate to severe	Slight to moderate	Slight
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
Shortleaf pine	E. redcedar			Black locust
Virginia pine	E. hemlock			Sumac
Black walnut	Hickories			American holly
White oak	American beech			Red maple
N. red oak	Chestnut oak			Carolina buckthorn
Yellow-poplar	Black oak			Blackgum
	S. red oak			Flowering dogwood
				Sourwood

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 19: Mountain Footslopes, Fans, Terraces, and Streambottoms with Good Drainage

Geographic Setting—Deep, silty and loamy alluvial soils with good internal drainage on level to strongly sloping footslopes, fans, terraces, and streambottoms along mountain streams and creeks in Subregion 2. Slope ranges from 0 to 15 percent but is generally less than 6 percent. Landtypes 19 and 20 occur as long, narrow, winding, sometimes discontinuous strips of land bordering mountain drainages.

Dominant Soils—Whitley, Rowdy, Cotaco, Barbourville, and Combs on footslopes, fans, and terraces; Cuba, Steff, Clifty, Grigsby, Pope, Philo, Skidmore, Ealy, and Sewanee on streambottoms.

Parent Material—Alluvium, possibly colluvium, washed from soils formed in residuum from acid sandstone, siltstone, and shale.

Depth to Bedrock—40 in to 20 ft or more.

Texture—Loam, silt loam, fine sandy loam, and sandy loam; occasionally gravelly. Rock fragment content ranges from zero to 35 percent in the solum and to 60 percent in lower B and C horizons.

Relative Soil Water Supply—High. Irrigated by subsurface flow. Seeps occur on footslopes in winter and spring. Streambottoms have seasonal water tables at depths of 2 to 5 ft for 1 to 3 months. Landtype is subject to occasional flash floods following short, high intensity and/or long, sustained rain storms.

Soil Fertility—Moderately high to high.

Vegetation—White oak, yellow-poplar, red maple, blackgum, sweetgum, and black oak; occasional northern red oak, American sycamore, scarlet oak, eastern white pine, eastern hemlock, shagbark hickory, shortleaf pine, Virginia pine, black willow, American elm, American beech, boxelder, black walnut, and river birch. Dogwoods, sassafras, sourwood, umbrella magnolia, American hornbeam, eastern hophornbeam, sumac, mountain-laurel, viburnums, azaleas, and cane are common understory species.

Table 23.—*Forest management interpretations for Landtype 19: Mountain footslopes, fans, terraces, and streambottoms with good drainage*

PRODUCTIVITY				
Species		Site index ¹	Average annual growth (ft ³ /acre)	
E. white pine		90	154	
Shortleaf pine		75	136	
Virginia pine		75	120	
White oak		75	57 – 62	
N. red oak		80		
Yellow-poplar		100	107	
Sweetgum		90	81	
American sycamore		(90)		
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Severe	Slight	Slight to moderate	Slight	Slight
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
E. white pine	Shagbark hickory			E. hemlock
Shortleaf pine	White oak			Black willow
Virginia pine	Black oak			River birch
Black walnut	Scarlet oak			American hornbeam
N. red oak	American elm			E. hophornbeam
Yellow-poplar				American beech
Sweetgum				Umbrella magnolia
American sycamore				Sassafras
				Red maple
				Boxelder
				Blackgum
				Dogwoods
				Sourwood

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 20: Mountain Terraces and Streambottoms with Poor Drainage

Geographic Setting—Deep, silty and loamy alluvial soils with poor internal drainage on level to gently sloping terraces and streambottoms along mountain streams and creeks in Subregion 2. Slope ranges from zero to 4 percent. Landtypes 19 and 20 occur as long, narrow, discontinuous strips of land bordering mountain streams.

Dominant Soils—Morehead on terraces; Stendal, Bonnie, Atkins, Stokly, and Bonair on streambottoms.

Parent Material—Alluvium washed from soils formed in residuum from acid sandstone, siltstone, and shale.

Depth to Bedrock—40 in to 10 ft or more.

Texture—Silt loam and silty clay loam; occasionally sandy loam, loam, and clay loam. Rock fragment content is 20 percent or less in the solum but ranges to 40 percent in lower B and C horizons.

Soil Drainage—Somewhat poorly drained to poorly drained.

Relative Soil Water Supply—High to very high. Water stands on the surface, or the water table is a foot or less below the surface for appreciable periods. This landtype is subject to occasional flash floods following short, high-intensity and/or long, sustained rain storms.

Soil Fertility—Moderately high to high.

Vegetation—Red maple, sweetgum, blackgum, yellow-poplar, white oak, American sycamore; occasional eastern cottonwood, pin oak, American elm, American beech, black willow, boxelder, and silver maple. Viburnums, azaleas, mountain-laurel, rhododendron, American holly, cane, sphagnum moss, alder, dogwoods, grasses, and sedges are common in the understory.

Table 24.—*Forest management interpretations for Landtype 20: Mountain terraces and streambottoms with poor drainage*

PRODUCTIVITY				
Species	Site index ¹		Average annual growth (ft ³ /acre)	
E. cottonwood	105			
Pin oak	95			
Yellow-poplar	90		90	
Sweetgum	90		81	
American sycamore	(90)			
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Moderate to severe	Moderate to severe	Severe	Slight	Slight
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
E. cottonwood	American elm			Black willow
White oak	Red maple			American hickory
Pin oak	Boxelder			American larch
Yellow-poplar				Silver maple
Sweetgum				Blackgum
American sycamore				Dogwood

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 21: Undulating Sandstone Mountain Uplands

Geographic Setting—Moderately deep to deep loamy and possibly silty soils on nearly level to rolling broad uplands that typically occupy the smoother, but not necessarily the highest parts, of the landscape in Subregions 1 and 2. Landtype 21 is most common in LTA-F but occurs in LTA's D, E, and G on lower mountains or foothills rather than on high mountain crests. Slope does not exceed 15 percent, but the area with slope greater than 10 percent is small and aspect is not a dominant site factor. These broad ridges range up to 0.5 mi in width. Soils formed in loamy residuum from acid sandstone, siltstone, and shale, and possibly in surficial deposits. Landtype 21 occurs in association with Landtypes 19, 20, 22, and 23.

Dominant Soils—Lily, Clarkrange, Lonewood, Crossville, Tilsit, and Clymer.

Bedrock—Acid sandstone, conglomerate, siltstone, and shale.

Depth to Bedrock—20 to 90 in. Clarkrange and Tilsit soils have fragipans at depths of 18 to 28 in.

Texture—Loam, fine sandy loam, sandy loam, and possibly silt loam. Rock fragment content is 10 percent or less in the solum, but deeper horizons may contain as much as 70 percent.

Soil Drainage—Well-drained except for Clarkrange and Tilsit, which are moderately well-drained.

Relative Soil Water Supply—Medium.

Soil Fertility—Moderately low.

Vegetation—White oak, scarlet oak, chestnut oak, southern red oak, hickories, black oak, blackgum, red maple, shortleaf pine, and Virginia pine; occasional yellow-poplar, eastern white pine, post oak, northern red oak, sweetgum, black locust, black cherry, and eastern redcedar. Flowering dogwood, sassafras, sourwood, serviceberry, persimmon, sumac, hawthorns, viburnums, azaleas, American holly, and smilax are common understory species.

Table 25.—*Forest management interpretations for Landtype 21: Undulating sandstone mountain uplands*

PRODUCTIVITY				
Species		Site index ¹	Average annual growth (ft ³ /acre)	
E. white pine		80	136	
Shortleaf pine		65	113	
Virginia pine		70	92	
White oak		70	52	
N. red oak		70		
Yellow-poplar		90	90	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Slight to moderate	Slight	Slight	Slight	Slight
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
E. white pine	Hickories			E. redcedar
Shortleaf pine	Post oak			Sassafras
Virginia pine	Chestnut oak			Serviceberry
White oak	Black oak			Hawthorns
N. red oak	S. red oak			Black locust
Yellow-poplar	Scarlet oak			Sumac
Black cherry	Sweetgum			American holly
				Red maple
				Blackgum
				Flowering dogwood
				Sourwood
				Persimmon

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 22:

Upper Mountain Slopes— North Aspect

Geographic Setting—Moderately deep, loamy and silty soils on the moderately steep to very steep upper one-fourth to one-third of north slopes in Subregions 1 and 2. Landtype 22 occurs over a wide range of elevations, from rugged high peaks, ridges, and foothills in LTA's D, E, and G to lower, less rugged mountains in LTA-F. These convex to linear slopes range from 16 to 75 percent in gradient. Soils formed in loamy residuum from acid siltstone, shale, and sandstone. Landtype 22 occurs below Landtypes 1, 3, and 21 in LTA-D and below Landtypes 21, 27, and 28 in LTA's E, F, and G. Landtype 22 occurs above Landtype 24, and the upper reaches of Landtype 19 may extend into Landtype 22. Areas of shallow soil and sandstone ledges may be extensive enough to recognize Landtype 2. Surface mines (Landtype 26) occur extensively in association with Landtype 22.

Dominant Soils—Muskingum, Gilpin, and Berks; possibly Dekalb and Steinsburg. Zenith and Cutshin occur at high elevation (above 2,500 ft) on slopes and in coves, particularly in LTA's E and G. Often mapped as soil complexes.

Bedrock—Siltstone, shale, coal, and clay; possibly sandstone and conglomerate.

Depth to Bedrock—20 to 40 in. Zenith and Cutshin soils are 70 to 80 in to rock.

Texture—Silt loam, loam, fine sandy loam, and sandy loam; possibly sandy clay loam and clay loam. Rock fragment content is usually less than 35 percent in the solum but is more in Berks and Dekalb soils. Deeper horizons may contain as much as 75 percent rock fragments.

Soil Drainage—Well-drained to somewhat excessively drained.

Relative Soil Water Supply—Medium to low.

Soil Fertility—Moderate to moderately low.

Vegetation—White oak, chestnut oak, yellow-poplar, northern red oak, black oak, red maple, and sugar maple; occasional black locust, white basswood, blackgum, Fraser magnolia, shortleaf pine, Virginia pine, hickories, eastern white pine, yellow buckeye, eastern hemlock, cucumbertree, black walnut, white ash, and sweet birch. Flowering dogwood, sassafras, sumac, eastern redbud, rhododendron, serviceberry, hydrangea, mountain-

Table 26.—*Forest management interpretations for Landtype 22: Upper mountain slopes—north aspect*

PRODUCTIVITY				
Species	Site index ¹		Average annual growth (ft ³ /acre)	
E. white pine	85		145	
Shortleaf pine	80		148	
Virginia pine	70		92	
White oak	(75)		57	
N. red oak	80		62	
Black oak	70		52	
Yellow-poplar	100		107	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Moderate to severe	Slight to moderate	Moderate severe	Moderate to severe	Slight to moderate
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
E. white pine	Hickories			E. hemlock
Shortleaf pine	Chestnut oak			Sweet birch
Virginia pine	Black oak			Fraser magnolia
Black walnut	Cucumbertree			Sassafras
White oak	Sugar maple			Serviceberry
N. red oak	Yellow buckeye			E. redbud
Yellow-poplar	White basswood			Black locust
White ash				Sumac
				American hornbeam
				Red maple
				Flowering dogwood

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 23:

Upper Mountain Slopes— South Aspect

Geographic Setting—Moderately deep, loamy and silty soils on the moderately steep to very steep upper one-third to one-half of south slopes in Subregions 1 and 2. Landtype 23 occurs over a wide range of elevations, from rugged high peaks, ridges, and foothills in LTA's D, E, and G to lower, less rugged mountains in LTA-F. These convex to linear slopes range from 16 to 75 percent in gradient. Soils formed in loamy residuum from acid siltstone, shale, and sandstone. Landtype 23 occurs below Landtypes 1, 4, and 21 in LTA-D and below Landtypes 21, 27, and 28 in LTA's E, F, and G. Landtype 23 occurs above Landtype 25, and the upper reaches of Landtype 19 may extend into Landtype 23. Areas of shallow soils and sandstone ledges may be extensive enough to recognize Landtype 2. Surface mines (Landtype 26) occur extensively in association with Landtype 23.

Dominant Soils—Muskingum, Gilpin, and Berks; possibly Dekalb and Steinsburg. Often mapped as soil complexes.

Bedrock—Siltstone, shale, coal, and clay; possibly sandstone and conglomerate.

Depth to Bedrock—20 to 40 in.

Texture—Silt loam, loam, fine sandy loam, and sandy loam. Rock fragment content is usually less than 35 percent in the solum but is more in Berks and Dekalb soils. Deeper horizons may contain as much as 75 percent rock fragments.

Soil Drainage—Well-drained to somewhat excessively drained.

Relative Soil Water Supply—Low.

Soil Fertility—Moderate to moderately low.

Vegetation—White oak, chestnut oak, scarlet oak, black oak, blackgum, red maple, shortleaf pine, and Virginia pine; occasional yellow-poplar, eastern white pine, northern red oak, hickories, black locust, sugar maple, white basswood, elms, yellow buckeye, cucumbertree, white ash, and magnolias. Flowering dogwood, sassafras, sourwood, serviceberry, sumac, hawthorns, viburnums, yuccinums,

Table 27.—*Forest management interpretations for Landtype 23: Upper mountain slopes—south aspect*

PRODUCTIVITY				
Species	Site index ¹		Average annual growth (ft ³ /acre)	
E. white pine	75		126	
Shortleaf pine	60		102	
Virginia pine	60		53	
N. red oak	65		48	
Black oak	60		43	
Yellow-poplar	(75)		63	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Slight	Moderate	Moderate to severe	Moderate to severe	Slight to moderate
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
E. white pine	Hickories			Magnolias
Shortleaf pine	Chestnut oak			Sassafras
Virginia pine	Black oak			Serviceberry
White oak	Scarlet oak			Black locust
N. red oak	Elms			Sumac
Yellow-poplar	Cucumbertree			Red maple
White ash	Sugar maple			Blackgum
	Yellow buckeye			Flowering dogwood
	White basswood			Sourwood

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 24: Colluvial Mountain Slopes, Benches, and Coves—North Aspect

Geographic Setting—Deep, loamy, often gravelly, cobbly, or stony soils on the sloping to steep lower two-thirds to three-fourths of north slopes in Subregions 1 and 2. The linear to concave slopes range from 15 to 60 percent. Soils formed in loamy colluvium from acid siltstone, shale, and sandstone. Landtype 24 is more common in LTA's E and G than in LTA's D and F. Landtype 24 occurs below Landtype 22 and above Landtypes 19 and 20. Surface mines (Landtype 26) occur extensively in association with Landtype 24. In places, this landtype merges with major river bottoms (Landtypes 29 and 30).

Dominant Soils—Jefferson, Grimsley, Shelocta, and Rigley. Zenith and Cutshin occur at high elevations (above 2,500 ft) on slopes and in coves, particularly in LTA's E and G. Often mapped as soil complexes.

Bedrock—Siltstone, shale, coal, and clay; possibly sandstone and conglomerate.

Depth to Bedrock—40 to 120 in or more.

Texture—Loam, fine sandy loam, sandy loam, and silt loam; occasionally sandy clay loam and clay loam. Rock fragment content varies considerably with short distances. Boulders and cobbles are common on the surface, particularly in coves.

Soil Drainage—Well-drained.

Relative Soil Water Supply—Medium to high.

Soil Fertility—Moderate to moderately high.

Vegetation—Yellow-poplar, northern red oak, white oak, hickories, black oak, red maple, and American beech; occasional sugar maple, cucumbertree, yellow buckeye, eastern hemlock, eastern white pine, white ash, blackgum, white basswood, and black birch. Flowering dogwood, mountain-laurel, American hornbeam, vacciniums, grape, viburnums, hydrangea, alder, and smilax are common understory species.

Table 28.—*Forest management interpretations for Landtype 24: Colluvial mountain slopes, benches, and coves—north aspect*

PRODUCTIVITY				
Species		Site index ¹	Average annual growth (ft ³ /acre)	
E. white pine		85	145	
Shortleaf pine		75	136	
Virginia pine		75	120	
White oak		75	57	
N. red oak		80	62	
Yellow-poplar		100	107	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Moderate to severe	Slight to moderate	Moderate severe	Moderate to severe	Slight to moderate
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
E. white pine	Hickories			E. hemlock
White oak	American beech			B. birch
N. red oak	Cucumbertree			American hornbeam
Black oak	Sugar maple			Serviceberry
Yellow-poplar	Yellow buckeye			Sumac
White ash	White basswood			Red maple
				Blackgum
				Flowering dogwood
				Sourwood

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 25: Colluvial Mountain Slopes, Benches, and Coves—South Aspect

Geographic Setting—Deep, loamy, often gravelly, cobbly, or stony soils on the sloping to steep lower one-half to two-thirds of south slopes in Subregions 1 and 2. The linear to concave slopes range from 15 to 60 percent. Soils formed in loamy colluvium from acid siltstone, shale, and sandstone. Lower parts of these slopes, particularly the coves, may be shaded by adjacent landmasses. Landtype 25 is more common in LTA's E and G than in LTA's D and F, and occurs below Landtype 23 and above Landtypes 19 and 20. Surface mines (Landtype 26) occur extensively in association with Landtype 25. In places, this landtype merges with major river bottoms (Landtypes 29 and 30).

Dominant Soils—Jefferson, Grimsley, Shelocta, and Rigley. Often mapped as complexes.

Bedrock—Siltstone, shale, coal, and clay; possibly sandstone and conglomerate.

Depth to Bedrock—40 to 120 in or more.

Texture—Loam, fine sandy loam, sandy loam, and silt loam; occasionally sandy clay loam and clay loam. Rock fragment content varies considerably within short distances. Boulders and cobbles are common on the surface, particularly in coves.

Soil Drainage—Well-drained.

Relative Soil Water Supply—Medium.

Soil Fertility—Moderate to moderately high.

Vegetation—White oak, chestnut oak, scarlet oak, hickories, black oak, red maple, Virginia pine, and shortleaf pine; occasional northern red oak, yellow-poplar, sugar maple, black locust, eastern hemlock, American beech, blackgum, and white ash. Flowering dogwood, American hornbeam, sassafras, eastern redbud, grape, hydrangea, sumac, and American holly are common understory species.

Table 29.—*Forest management interpretations for Landtype 25: Colluvial mountain slopes, benches, and coves—south aspect*

PRODUCTIVITY				
Species		Site index ¹	Average annual growth ² (ft ³ /acre)	
Shortleaf pine		65	113	
Virginia pine		70	92	
White oak } N. red oak }		70	52	
Yellow-poplar		(85)	80	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Moderate	Moderate	Moderate to severe	Moderate to severe	Slight
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
Shortleaf pine	Hickories			E. hemlock
Virginia pine	American beech			American hornbeam
White oak	Chestnut oak			Sassafras
N. red oak	Black oak			E. redbud
Yellow-poplar	Scarlet oak			Black locust
White ash	Sugar maple			Sumac
				American holly
				Red maple
				Blackgum
				Flowering dogwood

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 26: Surface Mines

Geographic Setting—Nearly vertical high walls and young, loamy, rocky soils forming in heterogeneous spoil resulting from area, contour, and auger types of surface mining for coal in Subregions 1 and 2. No distinction is made between unreclaimed (orphan) and reclaimed surface mines.

In contour mining (more common in LTA's E and G), the spoil is smoothed to form benches with steep to very steep outer slopes and to partially cover the high wall. Benches range from 70 to 150 ft or more in width, and the high walls are 60 ft or more in height. Contour mines occur at all elevations on mountain sides and tops. Nearly on the contour, they extend around the mountains in strips that range from a few hundred yards to several miles and encompass areas as large as 250 acres. Slopes are dominantly 12 to 20 percent on benches and 25 to 80 percent on outslopes. Ponds between the high wall and the spoil bank are common on orphan mines.

In area mining (more common in LTA's D and F), reclamation standards require restoration to approximate pre-mining topography. Area mining operations may cover several hundreds of acres. Slopes are usually less than 15 percent except in the vicinity of the final trench and in the heads of hollows at the margins of operations. Siltation ponds are now required on area mines.

Dominant Soils—Fairpoint and Bethesda. Formerly mapped as minespoils and surface mines. Reaction of Fairpoint soils is neutral to medium acid; that of Bethesda soils is strongly acid to extremely acid.

Parent Material—Formed in acid to neutral regolith from surface mining and occasionally in refuse from deep mining. Rock fragments consist of silt-

stone, shale, coal, and fine- and medium-grained sandstone. Fine-earth material is partially weathered rock fragments.

Depth to Bedrock—50 in to 50 ft or more.

Texture—The A horizon of unreclaimed areas is shaly, channery, or gravelly clay loam, silty clay loam, or silt loam. Reclaimed areas have 4- to 15-in-thick A horizons from natural soil material with textures of silt loam, loam, silty clay loam, or clay loam. From 35 to 80 percent of C horizons are composed of rock fragments.

Soil Drainage—Well-drained.

Relative Soil Water Supply—Low to medium.

Soil Fertility—Low. Soil reaction ranges from neutral to extremely acid except for surface layers that have been limed. Toxicities and deficiencies of plant nutrients are common in strongly to extremely acid soils. Shrink-swell potential is moderate.

Vegetation—Reclaimed areas have been seeded with grasses and/or legumes. Plantings of black locust, shortleaf pine, Virginia pine, and eastern white pine are common on all sites, while yellow-poplar, green ash, American sycamore, and sweetgum have been planted on cool and/or moist to wet sites. Unreclaimed mine soils have slowly revegetated naturally, and species occurrence depends on type of the spoil. Common woody species are eastern redcedar, black locust, Virginia pine, shortleaf pine, winged elm, hickories, white oak, scarlet oak, blackgum, post oak, blackjack oak, chestnut oak, black oak, sweetgum, red maple, American sycamore, black willow, sumac, and sassafras. Consult Vogel's (1981) guide for specific recommendations for revegetating mine soils.

Table 30.—*Forest management interpretations for Landtype 26: Surface mines*¹

MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Slight	Severe	Slight to severe	Severe	Slight
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
E. white pine	E. redcedar			Black w
Shortleaf pine	Hickories			Blackja
Virginia pine	White oak			Winged
Yellow-poplar	Post oak			Sassafr
Sweetgum	Chestnut oak			Sumac
American sycamore	Black oak			Blackgu
	Scarlet oak			
	Black locust			
	Red maple			
	Green ash			

¹ Data not available on productivity (species, site index, and average annual growth).

Description of Landtype 27: Narrow Shale Ridges, Points, and Convex Upper Slopes

Geographic Setting—Shallow to moderately deep, loamy and silty soils on sloping to very steep ridge-tops, points of ridges, and adjoining convex upper slopes in Subregion 2. Typically, these shale ridges are less than 350 ft wide. Slope ranges from 6 to 80 percent and is usually more than 15 percent. Soils formed in loamy and silty residuum from shale, siltstone, and, in places, fine-grained sandstone, and shale fragments are common on the surface. Landtype 27 occurs extensively on mountain crests at varying elevations in association with Landtypes 22, 23, 26, and 28. Often Landtype 27 is disturbed or entirely removed during surface mining of coal if seam(s) are at relatively shallow depths.

Dominant Soils—Petros, Muskingum, Weikert, and Berks.

Bedrock—Shale, siltstone, coal, clay, and fine-grained sandstone.

Depth to Bedrock—10 to 40 in.

Texture—Silt loam, loam, and fine sandy loam; often shaly or channery. Rock fragment content exceeds 35 percent in the solum and may be as much as 85 percent in C horizons.

Soil Drainage—Excessively well-drained to well-drained.

Relative Soil Water Supply—Very low to low.

Soil Fertility—Low.

Vegetation—Chestnut oak, scarlet oak, black oak, shortleaf pine, and Virginia pine; occasional red maple, blackgum, black locust, southern red oak, northern red oak, pitch pine, blackjack oak, post oak, white oak, and hickories. Flowering dogwood, vacciniums, sumac, sassafras, sourwood, and mountain-laurel are common understory species.

Table 31.—*Forest management interpretations for Landtype 27: Narrow shale ridges, points, and vex upper slopes*

PRODUCTIVITY				
Species		Site index ¹	Average annual growth (ft ³ /acre)	
Shortleaf pine		(55)	90	
Virginia pine		55	41	
Chestnut oak		55	38	
Black oak				
S. red oak				
N. red oak		60	43	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Slight	Severe	Moderate to severe	Slight to moderate	Moderate to severe
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
Shortleaf pine	Pitch pine			Blackjack oak
Virginia pine	Hickories			Sassafras
White oak	Post oak			Black locust
Chestnut oak	S. red oak			Sumac
N. red oak	Scarlet oak			Red maple
Black oak				Blackgum
				Flowering dogwood
				Sourwood

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 28: Broad Shale Ridges and Convex Upper Slopes

Geographic Setting—Moderately deep, silty and clayey soils on gently sloping to moderately steep rounded ridges and adjoining convex upper slopes in Subregion 2. Typically, these broad ridges are 1,000 ft or more wide. Slope ranges from 5 to 15 percent and aspect is not a dominant site factor. Soils formed in silty and clayey residuum from shale, siltstone and, in places, fine-grained sandstone. Landtype 28 occurs extensively on mountain crests at varying elevations in association with Landtypes 22, 23, 26, and 27 and is often disturbed by surface mining.

Dominant Soils—Gilpin, Wernock, Sequoia, and Latham.

Bedrock—Shale, siltstone, coal, clay, and fine-grained sandstone.

Depth to Bedrock—20 to 40 in.

Texture—Silt loam, loamy, and silty clay loam; occasionally shaly or channery. Rock fragment content usually is less than 35 percent in the solum but may exceed 35 percent in the C horizon.

Soil Drainage—Well-drained to moderately well-drained.

Relative Soil Water Supply—Low to medium.

Soil Fertility—Moderately low.

Vegetation—Chestnut oak, scarlet oak, black oak, hickories, shortleaf pine, Virginia pine, white oak, and red maple; occasional northern red oak, sugar maple, yellow-poplar, eastern white pine, black locust, blackgum, elms, and Fraser magnolia. Vacciniums, flowering dogwood, sumac, sassafras, sourwood, and smilax are common understory species.

Table 32.—*Forest management interpretations for Landtype 28: Broad shale ridges and convex upper slopes*

PRODUCTIVITY				
Species		Site index ¹	Average annual growth (ft ³ /acre)	
Shortleaf pine		65	113	
Virginia pine		70	92	
N. red oak		70	52	
Yellow-poplar		75	63	
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Slight to moderate	Slight	Slight to moderate	Slight	Slight
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
E. white pine	Hickories			Fraser magnolia
Shortleaf pine	Chestnut oak			Sassafras
Virginia pine	Black oak			Black locust
White oak	Scarlet oak			Sumac
N. red oak	Elms			Red maple
Yellow-poplar	Sugar maple			Blackgum
				Flowering dogwood
				Sourwood

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 29: **Footslopes, Terraces, and Flood** **Plains with Good Drainage**

Geographic Setting—Deep, loamy and silty alluvial soils with good internal drainage on level to strongly sloping footslopes, terraces, and flood plains along the Cumberland River and its major tributaries—Clear Fork, Elk Creek, and Elk Valley—in Subregion 3. Slope ranges from zero to 15 percent but is dominantly less than 10 percent. This landtype occurs in association with Landtype 30, which has poor internal drainage.

Dominant Soils—Allegheny, Monongahela, Cotaco, Whitley, and Rowdy on terraces; Cuba, Steff, Clifty, Pope, Philo, Huntington, and Combs on flood plains.

Parent Material—On terraces, soils formed in old silty alluvium or loess underlain by old alluvium, while on flood plains, soils formed in more recent alluvium. Alluvium washed from soils formed in residuum weathered from acid sandstones, siltstones, shales, and perhaps loess.

Depth to Bedrock—3½ to more than 10 ft. Monongahela soils have fragipan at depths ranging from 18 to 30 in.

Texture—Silt loam, loam, and fine sandy loam; occasionally sandy loam and silty clay loam. Solums usually contain less than 20 percent rock fragments. C horizons may contain more than 35 percent rock fragments.

Soil Drainage—Well-drained to moderately well-drained.

Relative Soil Water Supply—High. Low areas flood occasionally.

Soil Fertility—Moderately high to high.

Vegetation—White oak, sweetgum, yellow-poplar, blackgum, elms, red maple, northern red oak, river birch, and hickories; occasional American beech, black willow, pin oak, boxelder, black oak, American sycamore, black walnut, silver maple, white basswood, sourwood, eastern hemlock, Virginia pine, shortleaf pine, eastern white pine, persimmon, and sassafras. Dogwoods, eastern redbud, eastern hophornbeam, American hornbeam, cane, viburnums, American hazel, sumacs, and elder-

Table 33.—*Forest management interpretations for Landtype 29: Foothslopes, terraces, and flood plains with good drainage*

PRODUCTIVITY				
Species	Site index ¹		Average annual growth (ft ³ /acre)	
E. white pine	85		145	
Shortleaf pine	75		136	
Virginia pine	75		120	
N. red oak	80		62	
Yellow-poplar	95		98	
Sweetgum	90		81	
Sycamore	(90)			
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Moderate to severe	Slight	Slight to moderate	Slight to moderate	Slight
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
E. white pine	Hickories			E. hemlock
Shortleaf pine	American beech			River birch
Virginia pine	Black oak			American hornbeam
Black walnut	Elms			E. hophornbeam
White oak				Sassafras
N. red oak				American hazelnut
Pin oak				E. redbud
Yellow-poplar				Sumacs
Sweetgum				Red maple
American sycamore				Boxelder
White basswood				Blackgum
				Dogwoods
				Sourwood
				Persimmon

See footnotes 1 and 2 to table 5, p. 23.

Description of Landtype 30: Terraces and Flood Plains with Poor Drainage

Geographic Setting—Deep, loamy and silty alluvial soils with poor internal drainage on level to gently sloping terraces and flood plains along the Cumberland River and its major tributaries—Clear Fork, Elk Creek, and Elk Valley—in Subregion 3. Slope is 3 percent or less. This landtype occurs in association with Landtype 29, which has good internal drainage.

Dominant Soils—Morehead on terraces; Bonnie, Stendal, Atkins, Stokly, and Newark on flood plains.

Parent Material—On terraces, soils formed in old silty alluvium or loess underlain by old alluvium, while on flood plains, soils formed in more recent alluvium. Alluvium washed from soils formed in residuum weathered from acid sandstones, siltstones, shales, and perhaps loess.

Depth to Bedrock—5 to 10 ft or more.

Texture—Silt loam, loam, and silty clay loam; occasionally sandy loam and fine sandy loam.

Soil Drainage—Somewhat poorly drained and poorly drained.

Relative Soil Water Supply—High to very high. A fluctuating water table is near the surface part of the time, and the landtype is subject to occasional flooding.

Soil Fertility—Moderately high to high.

Vegetation—Pine oak, sweetgum, red maple, green ash, elms, and blackgum; occasional American sycamore, silver maple, shagbark hickory, river birch, yellow-poplar, black willow, and boxelder. Dogwoods, cane, grasses, sedges, and alder are common in the understory.

Table 34.—*Forest management interpretations for Landtype 30: Terraces and flood plains with drainage*

PRODUCTIVITY				
Species	Site index ¹		Average annual growth (ft ³ /acre)	
Yellow-poplar	90		90	
Sweetgum	90		81	
Pin oak	95			
MANAGEMENT PROBLEMS				
Plant competition	Seedling mortality	Equipment limitations	Erosion hazard	Windthrow hazard
Moderate to severe	Moderate to severe	Moderate to severe	Slight	Slight
SPECIES DESIRABILITY				
Most desirable	Acceptable			Least desirable
Pin oak	Hickories			Black willow
Yellow-poplar	Elms			River birch
Sweetgum	Red maple			Silver maple
American sycamore				Boxelder
Green ash				Blackgum
				Dogwood

See footnotes 1 and 2 to table 5, p. 23.

LITERATURE CITED

- Bailey, H. H.; Winsor, J. H. Kentucky soils. Misc. 308. Lexington, KY: University of Kentucky Agricultural Experiment Station; 1964. 174 p.
- Beck, D. E. Yellow-poplar site index curves. Res. Note 180. Asheville, NC; U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 1962. 2 p.
- Seeman, L. E. Computer-assisted resource management. In: Proceedings, Workshop on Integrated Inventories of Renewable Natural Resources, 1978 Jan. 8-12; Tucson, AZ. Gen. Tech. Rep. RM-55. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest Experiment Station; 1978: 375-381.
- Birdsey, R. A. Tennessee forest resources. Resour. Bull. SO-90. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1983. 35 p.
- Braun, E. L. Deciduous forests of eastern North America. Philadelphia, PA: The Blakiston Co.; 1950. 596 p.
- Broadfoot, W. M.; Krinard, R. M. Guide for evaluating sweetgum sites. Occas. Pap. 176. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1959. 6 p.
- Byrne, J. G.; Losche, C. K.; Gass, C. R.; Bottrell, G. D.; Avers, P. E.; Long, J. K.; Manhart, L. G. Soil survey of the McCreary-Whitley area, Kentucky. Washington, DC: U.S. Department of Agriculture, Soil Conservation Service; 1970. 83 p. + maps.
- Abredera, H. Patterns of species segregation as related to topographic form and aspect. Knoxville, TN: University of Tennessee; 1969. 111 p. M.S. thesis.
- Armean, W. H. Forest site quality evaluation in the United States. *Advances in Agronomy* 27: 209-269; 1975.
- Colton, G. W. The Appalachian Basin—its depositional sequences and their geological relationships. In: Fisher, G. W.; Pettijohn, F. J.; Reed, J. C., Jr.; Weaver, K. N., eds. *Studies of Appalachian geology, central and southern*. New York: Interscience Publ.; 1970: 5-47.
- Curtis, R. O.; Post, B. W. Site index curves for even-aged northern hardwoods in the Green Mountains of Vermont. Bull. 629. Burlington, VT: U.S. Department of Agriculture, Forest Service, Vermont Forest Experiment Station; 1978. 17 p.
- DeSelm, H. R.; Martin, W. H., III; Thor, E. The forest vegetation of Wilson Mountain, Tennessee. In: Pope, P. E., ed. *Proceedings, 2d Central Hardwood Forest Conference*, 1978 November 14-16; West Lafayette, IN: Purdue University; 1978: 23-28.
- Dietrich, R. V. *Geology and Virginia*. Charlottesville, VA: University of Virginia Press; 1970. 213 p.
- Doolittle, W. T. Site index comparisons for several forest species in the southern Appalachians. *Soil Science Society of America Proceedings*; 1958; 22: 455-458.
- Englund, K. J. *Geology and coal resources of the Eastern Valley area, Tennessee and Kentucky*. Prof. Paper 572. Washington, DC: U.S. Geological Survey; 1968. 59 p.
- Fenneman, N. M. *Physiography of eastern United States*. New York, NY: McGraw-Hill Book Co.; 1938. 714 p.
- Fernald, M. L. *Gray's manual of botany*. 8th ed. New York, NY: American Book Co.; 1950. 1,632 p.
- Franzmeier, D. P.; Pederson, E. J.; Longwell, T. L.; Byrne, J. G.; Losche, C. K. Properties of some soils in the Cumberland Plateau as related to slope, aspect, and position. *Soil Science Society of America Proceedings*; 1969; 33:755-761.
- Harris, L. D. Details of thin-skinned tectonics in the parts of Valley and Ridge and Cumberland Plateau provinces of the southern Appalachians. In: Fisher, G. W.; Pettijohn, F. J.; Reed, J. C., Jr.; Weaver, K. N., eds. *Studies of Appalachian geology, central and southern*. New York, NY: Interscience Publ.; 1970: 161-178.
- Hedlund, A.; Earles, J. W. Forest statistics for Tennessee counties. Resour. Bull. SO-32. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1970. 58 p.
- Hinkle, C. R. A preliminary study of the flora and vegetation of Cumberland Gap National Historical Park, Middlesboro, KY. Knoxville, TN: University of Tennessee; 1975. 236 p. M.S. thesis.
- Kingsley, N. P.; Powell, D. S. The forest resources of Kentucky. Resour. Bull. NE-54. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1978. 9 p.
- Knetsch, J. L.; Smallshaw, J. The occurrence of drought in the Tennessee Valley. Bull. T 58-2 A. Knoxville, TN: Tennessee Valley Authority; 1955.

ville, TN: University of Tennessee; 1979. 152 p. M.S. thesis.

Lee, R.; Sypolt, C. R. Toward a biophysical evaluation of forest site potential. *Forest Science* 20: 145 – 154; 1974.

Letzke, D. A.; Porter, H. C. Interpretative guide to the soils of southwest Virginia TVA counties: supplement to the soil surveys of Bland, Lee, Russell, Scott, Smyth, Tazewell, Washington, and Wise counties. Publ. 763. Blacksburg, VA: Extension Division, Virginia Polytechnic Institute and State University; 1978. 129 p.

Little, E. L., Jr. Checklist of United States trees (native and naturalized). *Agric. Handb.* 541. Washington, DC: U.S. Department of Agriculture, Forest Service; 1979. 375 p.

Moore, E. T. Our restless earth: the geologic regions of Tennessee. Knoxville, TN: University of Tennessee Press; 1977. 94 p.

McCarthy, E. F. Yellow-poplar characteristics, growth, and management. *Tech. Bull. No. 356.* Washington, DC: U.S. Department of Agriculture; 1933. 58 p.

McComb, W. C. Forestry and wildlife habitat management in central hardwoods. *Journal of Forestry* 80: 490 – 492; 1982.

McDonald, H. P.; Blevins, R. L. Reconnaissance soil survey of fourteen counties in eastern Kentucky. *Soil Conserv. Serv. Series* 1962, No. 1. Washington, DC: U.S. Department of Agriculture, Soil Conservation Service; 1965. 72 p. + maps.

McDowell, R. C.; Grabowski, G. J., Jr.; Moore, S. L. Geologic map of Kentucky. Lexington, KY: U.S. Geological Survey in cooperation with Kentucky Geological Survey; 1981. Scale 1:250,000.

McFarlan, A. C. *Geology of Kentucky.* Baltimore, MD: Waverly Press; 1943. 531 p.

McGinnis, R. C.; Spiker, C. T., Jr.; Wilson, J. M. (compilers). *Geologic map of Virginia.* Charlottesville, VA: Department of Conservation and Economic Development; 1963. Scale: 1:500,000.

McNeymaker, R. H. Soil survey of Anderson County, Tennessee. Washington, DC: U.S. Department of Agriculture, Soil Conservation Service; 1981. 165 p. + maps.

McNelson, T. C.; Clutter, J. L.; Chaiken, L. E. Yield of Virginia pine. *Stn. Pap.* 124. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1931. 61 p.

Smalley, G. W. Classification and evaluation of forest sites in the Interior Uplands. In: Pope, P. E., *Proceedings, 2d Central Hardwood Forest Conference, 1978 November 14 – 16; West Lafayette, IN: Purdue University; 1978: Addendum, 1 – 20.*

Smalley, G. W. Classification and evaluation of forest sites for timber production: introduction of a new system for classifying forest sites based on the physical features of the landscape. In: *Forest site and site quality workshop; 1979 May 8 – 10, Auburn, AL: Auburn University; 1979a: 28 – 47.*

Smalley, G. W. Classification and evaluation of forest sites on the southern Cumberland Plateau. *Gen. Tech. Rep. SO-23.* New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1979b. 59 p.

Smalley, G. W. Classification and evaluation of forest sites on the western Highland Rim and Pennyroyal. *Gen. Tech. Rep. SO-30.* New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1980. 120 p.

Smalley, G. W. Classification and evaluation of forest sites on the mid-Cumberland Plateau. *Gen. Tech. Rep. SO-38.* New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1982. 58 p.

Smalley, G. W. Classification and evaluation of forest sites on the eastern Highland Rim and Pennyroyal. *Gen. Tech. Rep. SO-43.* New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station; 1983. 123 p.

Smith, M. O.; Noger, M. C.; Smith, G. E. Some aspects of the stratigraphy of the Pine Mountain front near Elkhorn City, Kentucky with notes on pertinent structural features. *Geological Society of Kentucky Annual Spring Field Conference. Lexington, KY: Geological Society of Kentucky in cooperation with Kentucky Geological Survey; 1967. 24 p.*

Soil Conservation Service. General soil map, Kentucky. Lexington, KY: U.S. Department of Agriculture, Soil Conservation Service, in cooperation with Kentucky Agricultural Experiment Station and Division of Conservation, Department of Natural Resources and Environmental Protection; 1975. Scale 1:950,000.

Soil Conservation Service. General soil map, Virginia. Richmond, VA: U.S. Department of Agriculture, Soil Conservation Service, in cooperation with

Winger, M. L.; Brad, J. H. Soil of Tennessee. Agric. Exp. Bull. 596. Knoxville, TN: University of Tennessee Agricultural Experiment Station; 1980. 66 p. + maps.

Stearns, R. G.; Mitchum, R. M., Jr. Pennsylvanian rocks of southern Appalachians. Geol. Rep. Investig. No. 14. Nashville, TN: Tennessee Division of Geology; 1962. 26 p.

Wingfield, G. D.; Miller, R. A.; Luther, E. T.; Harde-
man, W. D.; Fullerton, D. S.; Sykes, C. R.; Garman,
R. K. (compilers). Geology map of Tennessee, east-
central sheet. Nashville, TN: Tennessee Division of
Geology; 1966. Scale 1:250,000.

Tennessee Division of Geology. Sedimentation semi-
nar, Mississippian and Pennsylvanian section on
Interstate 75 south of Jellico, Campbell County,
Tennessee. Geol. Rep. Investig. No. 38. Nashville,
TN; 1981. 42 p.

Snodgrass, E.; DeSelm, H. R.; Martin, W. H. Natural
reproduction on upland sites in the Cumberland
Mountains of Tennessee. Journal of the Tennessee
Academy of Science: 44: 96 – 100; 1969.

Northwaite, C. W. An approach toward a rational
classification of climate. Geographical Review 38:
55 – 94; 1948.

Trimble, G. R., Jr.; Patric, J. H.; Gill, J. D.; Moeller,
G. H.; Kochenderfer, J. N. Some options for man-
aging forest land in the Central Appalachians.
Gen. Tech. Rep. NE-12. Upper Darby, PA: U.S.
Department of Agriculture, Forest Service, North-
eastern Forest Experiment Station; 1974. 42 p.

U.S. Department of Commerce. Climatological data,

Kentucky annual summary. 71:13. Asheville, N.C.
U.S. Department of Commerce; 1976b. 14 p.

U.S. Forest Service. Volume, yield, and stand tab-
les for second-growth southern pines. Misc. Pub. 1-
50. Washington, DC; U.S. Department of Agricul-
ture, Forest Service; 1929 (slightly revised 1974).
202 p.

Vogel, W. G. A guide for revegetating coal mine
spoils in the eastern United States. Gen. Tech.
Rep. NE-68. Broomall, PA: U.S. Department of
Agriculture, Forest Service, Northeastern Forest
Experiment Station; 1981. 190 p.

Wertz, W. A.; Arnold, J. F. Land stratification for
land-use planning. In: Bernier, B.; Winget, C. J.,
eds. Forest soils and forest land management.
Quebec City, Quebec: Les Presses de l'Universite
Laval; 1975: 617 – 729.

Wilson, C. W., Jr.; Jewell, J. W.; Luther, E. T. Pen-
sylvanian geology of the Cumberland Plateau.
Tennessee Division of Geology Folio. Nashville,
TN: Tennessee Division of Geology; 1956. 21 p.

Wilson, C. W., Jr.; Stearns, R. G. Structure of the
Cumberland Plateau, Tennessee. Tennessee Re-
port. Investig. No. 8. Nashville, TN: Tennessee Divi-
sion of Geology; 1958. 15 p.

Winters, R. K.; Osborne, J. G. Growth and yield of
second-growth redgum in fully stocked stands on
alluvial lands in the South. Occas. Pap. 54. New
Orleans, LA: U.S. Department of Agriculture,
Forest Service, Southern Forest Experiment Sta-
tion; 1935. 12 p.

APPENDIX

COUNTY SOIL SURVEYS AVAILABLE FOR THE CUMBERLAND MOUNTAINS

Byrne, J. G., C. K. Losche, C. R. Gass, G. D. Bot-
trell, P. E. Avers, J. K. Long, and L. G. Manhart.
1970. Soil survey of the McCreary-Whitley area,
Kentucky. U.S. Dep. Agric. Soil Conserv. Serv. 83
p. + maps.

McDonald, H. P. and R. L. Blevins. 1965. Recon-
naissance soil survey of fourteen counties in east-

ern Kentucky. U.S. Dep. Agric. Soil Conserv. Serv.
Series 1962, No. 1. 72 p. + maps.

*Money maker, R. H. 1981. Soil survey of Anderson
County, Tennessee. U.S. Dep. Agric. Soil Conser-
v. Serv. 165 p. + maps.

*Survey contains a section for woodland suitability.

METRIC EQUIVALENTS

1 inch = 2.54 centimeters (exactly)

1 foot = 0.3048 meter (exactly)

1 acre = 0.4047 hectare

1 square foot/acre = 0.2296 square meter/hectare

1 cubic foot/acre = 0.06997 cubic meter/hectare

1 mile = 1.6093 kilometers

1 square mile = 2.5900 square kilometers

$^{\circ}\text{C} = (^{\circ}\text{F} - 32) / 1.8$

Smalley, Glendon W. 1984. Classification and evaluation of forest sites in the Cumberland Mountains. U.S. Dep. Agric. For. Serv. Gen. Tech. Rep. SO-50. 84 p.

Presents a comprehensive forest site classification system for the Cumberland Mountains in north-central Tennessee, southeast Kentucky, and southwest Virginia. The system is based on physiography, geology, soils, topography, and vegetation.

Additional keywords: Site index, mean annual increment, soil properties, pines, hardwoods.